NINTH ANNUAL REPORT

OF THE

BOARD OF REGENTS

OF THE

SMITHSONIAN INSTITUTION,

SHOWING THE

OPERATIONS, EXPENDITURES, AND CONDITION OF THE INSTITUTION
UP TO JANUARY 1, 1855.

AND THE

PROCEEDINGS OF THE BOARD UP TO FEBRUARY 24, 1855.

WASHINGTON:
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1855.

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LETTER

OF THE

SECRETARY OF THE SMITHSONIAN INSTITUTION,

COMMUNICATING

The Ninth Annual Report of the Board of Regents of that Institution.

March 1, 1855.—Read and ordered to be printed—motion to print 10,000 additional copies referred to Committee on Printing.
March 2, 1855.—Ordered that 10,000 additional copies be printed, 2,500 of which be for the use of the Smithsonian Institution.

Smithsonian Institution,
Washington, February 28, 1855.

Sir: In behalf of the Board of Regents, I have the honor to submit to the Senate of the United States, the Ninth Annual Report of the operations, expenditures, and condition of the Smithsonian Institution.

I have the honor to be, very respectfully, your obedient servant,

JOSEPH HENRY,
Secretary Smithsonian Institution.

Hon. Jesse D. Bright,
President of the Senate.

NINTH ANNUAL REPORT

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BOARD OF REGENTS

OF THE

SMITHSONIAN INSTITUTION,

SHOWING THE

OPERATIONS, EXPENDITURES, AND CONDITION OF THE INSTITUTION UP TO JANUARY 1, 1855, AND THE PROCEEDINGS OF THE BOARD UP TO FEBRUARY 24, 1855.

To the Senate and House of Representatives:

In obedience to the act of Congress of August 10, 1846, establishing the Smithsonian Institution, the undersigned, in behalf of the Regents, submit to Congress, as a Report of the operations, expenditures, and condition of the Institution, the following documents:

1. The Annual Report of the Secretary, giving an account of the operations of the Institution during the year 1854.
2. Report of the Executive Committee, giving a general statement of the proceeds and disposition of the Smithsonian fund, and also an account of the expenditures for the year 1854.
3. Report of the Building Committee, relative to the progress made in 1854 in the erection of the Smithsonian edifice.
4. Proceedings of the Board of Regents up to February 24, 1855.
5. Appendix.

Respectfully submitted.

ROGER B. TANEY, *Chancellor.*
JOSEPH HENRY, *Secretary.*

FEBRUARY 28, 1855.

OFFICERS OF THE SMITHSONIAN INSTITUTION.

FRANKLIN PIERCE, *Ex officio* Presiding Officer of the Institution.
ROGER B. TANEY, Chancellor of the Institution.
JOSEPH HENRY, Secretary of the Institution.
SPENCER F. BAIRD, Assistant Secretary.
W. W. SEATON, Treasurer.
WILLIAM J. RHEES, General Assistant.

ALEXANDER D. BACHE, JAMES A. PEARCE, JOSEPH G. TOTTEN,	Executive Committee.
RICHARD RUSH, WILLIAM H. ENGLISH, JOHN T. TOWERS, JOSEPH HENRY,	Building Committee.

REGENTS OF THE INSTITUTION.

—— ——, Vice President of the United States.
ROGER B. TANEY, Chief Justice of the United States.
JOHN T. TOWERS, Mayor of the city of Washington.
JAMES A. PEARCE, member of the Senate of the United States.
JAMES M. MASON, member of the Senate of the United States.
S. A. DOUGLAS, member of the Senate of the United States.
W. H. ENGLISH, member of the House of Representatives.
DAVID STUART, member of the House of Representatives.
JAMES MEACHAM, member of the House of Representatives.
GIDEON HAWLEY, citizen of New York.
J. MACPHERSON BERRIEN, citizen of Georgia.
RICHARD RUSH, citizen of Pennsylvania.
ALEXANDER D. BACHE, member of the National Institute, Washington.
JOSEPH G. TOTTEN, member of the National Institute, Washington.

MEMBERS EX OFFICIO OF THE INSTITUTION.

FRANKLIN PIERCE, President of the United States.
——— ———, Vice President of the United States.
WILLIAM L. MARCY, Secretary of State.
JAMES GUTHRIE, Secretary of the Treasury.
JEFFERSON DAVIS, Secretary of War.
JAMES C. DOBBIN, Secretary of the Navy.
JAMES CAMPBELL, Postmaster General.
CALEB CUSHING, Attorney General.
ROGER B. TANEY, Chief Justice of the United States
CHARLES MASON, Commissioner of Patents.
JOHN T. TOWERS, Mayor of the city of Washington

HONORARY MEMBERS.

ROBERT HARE.
WASHINGTON IRVING.
BENJAMIN SILLIMAN.
PARKER CLEAVELAND

REPORT OF THE SECRETARY.

To the Board of Regents of the Smithsonian Institution:

GENTLEMEN: It again becomes my duty to present to your honorable Board the Annual Report of the present condition of the Smithsonian Institution, and of its operations during the year 1854.

In this report I shall follow the course adopted in the previous ones, namely, to state such facts as may appear to be necessary to a connected history of the Institution, and to offer such suggestions as may seem important in reference to its future management.

At no period since the commencement of the Institution has it attracted more attention, or given rise to more discussion, than during the past year; but, thanks to the liberality of Congress, who ordered the printing of twenty thousand extra copies of the last report, to which were appended all the preceding reports of the secretary, together with sundry other documents, ample means have been afforded the reading public to become acquainted with the will of Smithson, his pursuits in life, with the law of Congress establishing the Institution, and with all the acts of the Regents in the discharge of their duty.

That the disposition of a bequest of so novel a character, the intention of which was so briefly though comprehensively expressed, should give rise to a diversity of opinion, or that the act of Congress in reference to it, which received repeated amendments, and was passed, after a discussion of several years, by a small majority, should be differently construed, is not surprising.

In the language of Mr. Adams: "A British subject, of noble birth and ample fortune, desiring to bequeath his estate to the purpose of increasing and diffusing knowledge throughout the whole community of civilized man, selected for the repository of his trust, with confidence unqualified, the United States of America. In the commission of every trust there is an implied tribute to the integrity and intelligence of the trustee; there is, also, an implied call for the faithful exercise of those properties to the fulfilment of the purposes of the trust. The tribute and the call acquire additional force and energy when the trust is committed for performance after the decease of him by whom it is confided, and when he no longer exists to witness or constrain the effective fulfilment of his design. The magnitude of the trust, and the extent of confidence bestowed in the committal of it, do but enlarge and aggravate the obligation which it carries with it. The weight of duty imposed is in proportion to the honor conferred by confidence without reserve."

"The principal purpose of Mr. Smithson was, evidently, the discovery of new truths, the invention of new means for the enlargement of human power, and not the mere communication of knowledge already r

sessed. In this point of view the bequest assumes an interest of the highest order, peculiar to itself, most happily adapted to the character of our republican institutions, and destined, if administered in the spirit in which it was bestowed, to command the grateful acclamations of future ages." No restriction is made as to any kind of knowledge; but it is knowledge, the source of all human wisdom and beneficent power, which is to be increased and diffused; "knowledge, which as far transcends the postulated lever of Archemides, as the universe transcends this speck of earth upon its face; knowledge, the attribute of Omnipotence, of which man alone, in the physical and material world, is permitted to participate." Let not, then, any branch or department of human knowledge be excluded from its equitable share of this benefaction. Again, no nation, community, or class of men, is designated as the special recipient of this bounty; and it would be inconsistent with the self-respect of a great confederated nation to receive, from the hands of a foreigner, a liberal fund for the increase and diffusion of knowledge throughout the world of man, and to apply it exclusively to its own purposes.

The Regents, at their first session, conscious of the importance and magnitude of the trust confided to them, and of the responsibilities which devolved upon them, gave to the whole subject attentive and laborious consideration. They were impressed with the fact that the object of the law was to carry out the will of Smithson, and if there were any doubtful points, it was their duty to construe them with a view to this object. In conformity with this a plan was adopted, which, while it fulfilled all the requirements of the law, was in strict accordance with a logical interpretation of the will of the donor. This plan, after seven years' experience, has been found to realize all the hopes and anticipations which were entertained in regard to it by its most sanguine advocates; and, though it was adopted provisionally, to be changed or modified as circumstances might indicate, yet no essential alteration has been considered necessary by those best acquainted with its operations. It is true that it is not, perhaps, in all respects, the simplest plan which could have been designed for carrying out the will of the testator; and had the Regents been entirely unrestricted, they would probably have devoted a less portion of the income to local objects; but, under all the conditions of the problem, it is believed that it was the best which could have been adopted to produce the desired result. And it may not be too much to say, that the present condition of the Institution, as to general reputation and financial prosperity, is much more favorable than experience in the management of public trusts would reasonably have led us to anticipate.

All the requirements of the act of Congress, in the opinion of the Regents, have been faithfully and fully observed. Liberal provision has been made for the accommodation of a library, a museum, and a gallery of art, with lecture rooms and a laboratory, in the construction of a building which has cost $300,000. A *library* has been commenced and means devised for its continual extension, which will soon form the best special collection of valuable works pertaining to all branches of positive knowledge to be found in this country. The books which it now contains, if estimated by the prices paid for those which have

been purchased, may be valued at not less than $40,000. A *museum*, the most complete of any in existence in several branches of the natural history of the North American continent, has been collected, which has been valued at $30,000. A valuable and extensive cabinet of *apparatus*, consisting of instruments of illustration and research, has been formed. A beginning has also been made of a *gallery of art*, consisting of a choice collection of specimens of engravings by the old masters.

Not only have the objects specified by Congress received due attention, but also by a series of *active operations* the influence of the Institution has been extended to almost every part of our own and foreign countries. The publications, the exchanges, and the researches which have been instituted and prosecuted by the Institution, have indissolubly connected the name of SMITHSON with the progress of knowledge in our day.

In accomplishing these objects the funds have not been exhausted, nor have debts been incurred. On the contrary, by strict adherence to a well devised system of finance, not only does the fund originally bequeathed by SMITHSON remain undiminished in the Treasury of the United States, but there is now on hand nearly $140,000 of unexpended income to be added to the principal.

In other words, the funds and property are now estimated at double the amount of the original bequest.

The plan of increasing and diffusing knowledge by means of researches and publications is in strict accordance with the will of Smithson. It embraces as a leading feature the design of interesting the greatest number of individuals in the operations of the Institution, and of extending its influence as widely as possible. It supplies a want which has long been felt in this country, and offers a greater inducement to profound study by rendering the products of original research more available than any other plan heretofore proposed. Every one who makes a discovery in any department of knowledge must of necessity be somewhat in advance of the reading public, at least in the special branch to which his discovery pertains; and therefore the number of readers, and consequently of purchasers of a work giving an account of these discoveries will be comparatively small. "I have frequently congratulated myself," says one of our collaborators, "upon living at a time when an Institution exists in our country which would publish discoveries and original investigations or positive additions to knowledge, without expense to the author. What would not poor Morton have done had he been able in this way to publish his researches, whereas his single work on *Crania Americana* was given to the world at the loss of several thousand dollars."

The Institution does much more than ordinary societies in the way of stimulating research. It not only gives to the world with the stamp of its approval the various papers which constitute its contributions to knowledge, but in a large number of cases it furnishes materials and pecuniary means for carrying on the investigations. The aid which it affords in this way, though small in amount, is sufficient to determine whether an investigation shall be prosecuted to a successful termination or abandoned almost at its very commencement.

It was at first proposed to offer premiums for original memoirs on

different branches of knowledge; but it has been found by experience that the inducements held out by the offer of publication free of expense under the sanction of the Institution, and the assistance which is occasionally afforded, will produce more material of the first quality than will exhaust the small portion of the income which can be devoted to researches and publication.

In first proposing the system of literary exchanges which is now extended over every part of the civilized world, a promise was made to all the foreign societies which should send their transactions to the Smithsonian library that, on the part of the Institution, at least one quarto volume of original contributions to knowledge would annually be given in return. The experience of seven years has rendered it evident that this promise can be fully redeemed. Indeed, were the funds sufficient, two large volumes might be published in the same time.

The seventh volume is nearly completed, and will be ready for distribution in the course of a few weeks. It will contain a number of memoirs, the largest of which are on the subject of American antiquities. An account of one of these, viz., that on the *Effigy Mounds* of Wisconsin, was given in the last report.

A number of memoirs have been examined and accepted for publication since the date of the last report.

1. A paper has been prepared at the special request of the Institution, by S. F. Haven, esq., librarian of the American Antiquarian Society, Worcester, Massachusetts, which will form a part of the seventh volume.

Its intention is to give a retrospective view of the progress of knowledge and opinions relative to the whole subject of American antiquities. For this purpose the author has, in the first place, presented a summary of the opinions of early writers upon the question of the origin and sources of the native population of this country, and in this connexion has noticed some of the more prominent writers of later date who have sustained one or other of the ancient hypotheses.

In the second place he has considered the accounts of the early Spanish and French adventurers, and the reports of the Jesuit missionaries, who first became acquainted with the inhabitants in their native condition, so far as those accounts have a bearing on the origin and uses of the earth-works of this country.

In the third place he has sought to ascertain the names of the early explorers who examined and described any of these ancient remains, and to give the extent of their investigations.

He has next followed the succession of observations and speculations of different periods down to the present time; and, lastly, he has given a concise *resumé* of the facts which have thus far been established.

These are, 1st. The nature and extent of the aboriginal monuments in the United States east of the Rocky mountains;

2d. Their location relatively to one another and to different portions of the country;

3d. Their affinities to the works of existing or recently extinct tribes.

The memoir is intended to have a bibliographical character, so far as this could be effected without interrupting the continuity of the narrative. It will be found important, not only in pointing out what has

been done and thought on this interesting subject, but also in indicating definite points of further research.

The preparation of this article has cost the author no small amount of labor. The information was principally to be found in publications which, in their day, had but a limited circulation; and now, even, when known to exist, are not easily found. It may be interesting to mention that there have been several periods during which attention has been particularly directed to the aboriginal remains of this country, and between them intervals of time in which they excited comparatively no interest. Before the war of the revolution, investigations had been commenced, which were of course suspended or terminated by that event. After peace was restored and military stations were established in the interior, and settlements began to be extended beyond the Ohio, accounts of remarkable works were published in the miscellaneous periodicals of the day. The officers of the army were the principal explorers; but two of the most active of these, General Parson and General Heart, were removed by death; and as the mounds became more familiar to the settlers, the interest in them comparatively declined. After the war of 1812, they again became the object of inquiry, which resulted in the publication of Mr. Atwater's researches under the auspices of the American Antiquarian Society. Since then, though occasional articles appeared, no important additions were made to our knowledge in regard to them until the publication of the first volume of the Smithsonian Contributions. The reputation acquired by this work has induced a number of other laborers to enter the field, which, we trust, will soon be fully explored. Indeed, it is believed that samples of nearly every variety of earth-work to be found within the limits of the territory of the United States, east of the Rocky mountains, have been figured in the publications of the Institution. It is intended, however, to continue to collect all the information which may be obtained, and in due time to publish a map of the relative position of all the works which are found to exist, at least within the limits of the United States.

The Institution from the first has given particular attention to antiquities, philology, and other branches of the new and interesting department of knowledge called ethnology, which relates to the natural history of man in his physical, moral, intellectual, and æsthetical characteristics. It is a common ground, in the cultivation of which lovers of literature and science are equally interested. The works we have thus far published on these subjects have elicited the highest commendations, and the Smithsonian Contributions are now generally referred to as containing important materials for their elucidation.

2. Some years ago an artist of considerable merit and great accuracy, Mr. Sawkins, visited the celebrated remains of ancient architecture at Mitla, in the State of Oajaca, Mexico. Mr. Sawkins made careful drawings of the ruins by means of a *camera lucida*, and recorded his observations upon the spot. Within a few months these drawings and memoranda have come into the possession of Mr. Brantz Mayer, of Baltimore, whose writings upon Mexico and its antiquities have been very largely circulated in this country during the last six or seven years. Mr. Mayer considered Mr. Sawkins's sketches and observations

as of so much value to the aboriginal history of our continent, and especially in completing the links of civilization between North and South America, that he prepared a brief memoir upon Zapotec remains, which the Institution has considered it advisable to publish with the drawings. We are happy to believe that this contribution will in some degree supply a deficiency which has been often acknowledged in regard to remains on the western slopes of the Mexican Cordillera.

3. Another memoir presented to the Institution is on the *Recent secular visitation of the Aurora Borealis*, by Professor Denison Olmsted, of Yale College. This paper partakes more largely of a hypothetical character than most of those which have been accepted for publication. The facts, however, which it contains are considered so important and so well deserving of permanent record, that they outweigh this objection.

On the evening of the 27th of August, 1828, after a long absence of any striking appearances of the aurora borealis, there commenced a series of exhibitions which increased in frequency and magnificence for the six following years, arrived at a maximum during the years 1835,–'6,–'7, and after that period regularly declined in number and intensity until November, 1848, when, according to the author, the series appeared to come to a close. The occurrence, however, of three remarkable exhibitions of the aurora during September, 1851, and of another of the first class as late as February, 1852, indicate that the close was not as abrupt as was at first supposed, but still there was a diminution in the number of brilliant exhibitions after 1848. Professor Olmsted, in this memoir, gives the history of the foregoing series of auroras, which, in his opinion, are the most remarkable which have ever occurred since the first recorded observations. The author first refers the several varieties of the aurora to six different forms, viz: 1. Auroral light; 2. Arches; 3. Streamers; 4. Coronas; 5. Waves; 6. Auroral clouds; and afterwards distributes these different forms into four distinct classes. The first is characterized by the presence of three out of four of the most prominent varieties, viz: arches, streamers, coronas, and waves.

The second class is formed of a combination of two or more of the leading characteristics of the first class.

The third class consists of the presence of only one of the rarer characteristics, either streamers or an arch, or irregular coruscations.

Class fourth consists of the most ordinary form of the aurora, as mere northern twilight or a few streamers.

From the year 1780 to 1827 striking exhibitions of the aurora were seldom observed, although, probably, a greater or less number of the inferior descriptions of those of the third and fourth classes occurred every year in our own latitude, and a still greater number in the regions nearer the poles. But aged persons who witnessed the displays of 1827, 1835, 1836, and 1837, testify that they were similar to such as occurred in their youth from 1760 to 1781. Strange sights were described as having been seen in the air during the old French war, which closed in 1763. From 1781 none of equal intensity had occurred for nearly half a century; the splendid arch, therefore, and other striking accompaniments of the aurora of 1827 took us by surprise, and

were viewed with wonder by nearly all the existing generation. Immediately after this great aurora, exhibitions of the phenomenon became more frequent. From 1827 to 1848, 885 appearances of the aurora are given in the records referred to by the author. Of these, 12 were of the first class, 45 of the second, 161 of the third, and 667 of the fourth.

The author places the middle of the period about 1837; and by subtracting from this 65 years, he arrives at the middle of another visitation. The duration of the period he considers to be a little more than 20 years. The middle of the next period of brilliancy, if this assumption be correct, will be about the beginning of the next century. Whatever may be the truth of this conclusion, the description of a large number of auroras which he has collected, given either from the records of others or from his own observations, renders his communication valuable. He does not adopt the hypothesis of the electrical origin of this meteor, but considers it connected with the phenomena of the zodiacal light. The most conclusive proof, however, of the truth of the former hypothesis is found in the fact of the disturbance of the magnetic needle, when delicately suspended, during the appearance of the aurora, and the actual transmission of currents of electricity along the lines of telegraphs which extend in a north and south direction. The last fact has been reported separately to us by different individuals belonging to the Smithsonian corps of observers.

Though no complete explanation has been given of all the facts of the aurora, yet the most plausible hypothesis is that which attributes the phenomena to electricity generated principally in the torrid zone by evaporation. By this process the earth is rendered negative, and the vapor which ascends into the upper atmosphere highly positive. It is thence transferred towards the poles by the return trade winds, and descends to the earth to restore the equilibrium. A current of electricity is thus constantly passing from the poles to the equator during the appearance of the aurora; and hence, according to this view, the disturbance of the needle.

As an appendix to this paper, Peter Force, esq., of this city, has presented to the Institution an extended series of notices of the aurora collected from all the publications in which they occur, from about 1827 to the present year, arranged in order of time and of latitude. This will be a valuable contribution of facts towards a definite determination of the law and physical cause of these mysterious meteorological phenomena.

It would scarcely be complimentary to the general intelligence of the public of the United States, if I were again to attempt to vindicate the importance of investigations like that of the aurora; and it may be a sufficient answer to those who would question it, to say that they are such as particularly occupied the attention of Smithson himself, and that they must, consequently, be included as a part of that knowledge which it was the intention of his bequest to increase and diffuse among men.

4. The next paper is on the Tangencies of circles and spheres, by Major B. Alvord, of the United States army. It consists in the solution of a series of problems which have at different times exercised the ingenuity and skill of the geometer. It was referred separately for examination to Professor Lewis R. Gibbes, of Charleston, South

Carolina, and Professor A. E. Church, of West Point. In the language of one of the examiners: "The solutions of the problems relating to the circles, though not entirely original, are yet brought more directly to depend upon the fundamental principle of tangency as enunciated by the author, and are more elegant, than those given in any works with which I am acquainted. The paper also presents the only clear and complete explanation of the number of solutions and of the various positions of the tangent circles (and spheres) in each case that I have seen. I have not been able to find heretofore any complete solutions of all the problems relating to the sphere. Those of the author of the memoir are accurate, and easy to be understood by any person familiar with the elements of solid and descriptive geometry, and I think their publication will furnish a valuable addition to geometrical knowledge.'

It is a fact not without interest, that an officer of the army is enabled, while discharging his duty at a distant post of the frontier of our country, to concentrate his thoughts, and exercise his talents, on so abstruse a part of pure mathematics. The paper will be illustrated by three engraved plates in quarto.

5. A dictionary of the Chippewa language has been offered to the Smithsonian Institution for publication by the Rev. S. A. Belcourt, a missionary among the Indians of British America. He has devoted 23 years to the study of this language. He urges its adoption by the Institution on the ground that in all probability this work, which, to use his own language, "has cost me so many years of labor and nights of thought, and which, in my humble opinion, will be valuable to science and philanthropy, especially to philology, will forever be lost; and who would undertake a work of such magnitude after learning the fate of this?"

The language of the Ojibewas, according to the author, is the parent of all the dialects existing from the mouth of the St. Lawrence north and following the 27th parallel to the source of the Missouri. Were the present funds of the Institution sufficient for the purpose we should not hesitate to accept this work, and we are not entirely without hope that some means may be procured independent of the Institution to defray a considerable portion of the expense of its publication.

Correspondence.—During the past year the Institution has received a large number of communications asking information on a variety of subjects, particularly in regard to the solution of scientific questions, the names and characters of objects of natural history, and the analysis of soils, minerals, and other materials which pertain to the industrial resources of the country. Answers have in all cases been given to these inquiries, either directly by the officers of the Institution, or by reports from the Smithsonian colaborers. Very frequently certificates are requested as to the value of certain minerals, with a view to bring them into market; but in these cases the inquirers are referred to certain reliable analytical chemists, who make a business of operations of this kind. The information procured and given at the expense of the Institution is such as relates to the general diffusion of knowledge, and not to that which may immediately tend to advance the pecuniary interest of individuals. Requests are often also made to have experiments instituted for testing proposed applications of science to the arts; and

provided these can be tried with the apparatus of the Institution, and the results which may flow from them are to be given to the public without the restriction of a patent, the request is granted.

EXPLORATIONS, RESEARCHES, &c.—(1.) About the beginning of the year 1853, Lieutenant D. N. Couch, U. S. A., communicated to the Smithsonian Institution a proposition to make at his own expense a scientific exploration in the States of Mexico, adjoining the lower Rio Grande. After this proposition was duly considered, and the details of the plan arranged, it was commended by me in a letter to the Secretary of War, and a request made that Lieutenant Couch might have leave of absence for the purpose of carrying out his design. The request was granted, and this young officer soon after embarked on his expedition. He was furnished with instructions and apparatus by the Institution, and his attention was especially directed to the existence in Mexico of a valuable collection of manuscripts and specimens in natural history, of which information had been communicated to us. He was requested to examine and report as to its character. He found the manuscripts to contain a large amount of historical and geographical information, chiefly pertaining to the States of the old republic which lay between the Sabine and Sierra Madre, and a series of maps and results of topographical and meteorological observations. The collections in natural history consisted of specimens in botany, zoology, mineralogy, &c.

These collections were made by Luis Berlandier, a native of Switzerland, and a member of the Academy of Geneva. He came to Mexico in 1826, for the purpose of making a scientific examination of that country. Soon after his arrival he was appointed one of the Boundary Commission organized by the then new republic, with the object of defining the boundaries, extent, resources, &c., &c., of the northern or frontier States. This position gave him unusual facilities for observation and investigation relative to the character of the country, and for making collections of its natural history. He, however, never returned to his native country, but married and settled in Mexico, and continued his researches until the period of his death in 1851. Lieutenant Couch purchased the whole collection from the widow of the deceased, and transmitted it immediately to the Institution, which bore the expense of transportation. It contains matter which would be valuable to the general government, and which it is hoped will be purchased, and a sufficient sum paid to reimburse the cost of procuring it. In the appendix will be found a catalogue of the manuscripts.

Lieutenant Couch himself collected a large number of specimens in natural history, which were presented to the Institution, and have already been examined and described. Among the specimens of mineralogy is a remarkable meteorite, weighing upwards of 250 pounds, portions of which have been analyzed by Professor J. Lawrence Smith, in our laboratory, and by Dr Genth, in Philadelphia.

The scientific explorations in natural history, made under the auspices of the Smithsonian Institution during 1854, were those of Dr. Hoy, Mr. Barry, and Professor Baird. That of Dr. Hay was made in western Missouri and Kansas, and occupied about a month; during which he gathered together large collections of North American vertebrata,

and forwarded them to the Institution. Mr. Barry took northern Wisconsin for the field of his labors, and spent several months in traversing the State, penetrating into various regions scarcely visited before by the white man. Several lakes and streams, not on the map, were discovered, and named by him. His most important results consisted in very full series of fishes from many localities. Professor Baird spent six weeks on the coast of New Jersey, at Beesley's Point, collecting specimens, and studying the habits of the marine fishes of the neighborhood. Thence he proceeded to several places on Long Island, especially to Greenport and Riverhead; and afterwards made explorations at various points on and near the Hudson river, as far north as Sing Sing. Full series of fishes and crustacea were procured at all these places, and sent to the Smithsonian Institution.

(2.) *Terrestrial Magnetism.*—The observatory established at the joint expense of the Coast Survey and the Institution, described in the last report, for determining the changes in the different elements of the magnetic force, has not yet been fully supplied with all the necessary instruments. This has been occasioned by the illness of Mr. Brooks, of England, the inventor, who has not been able to furnish the apparatus for recording the variations in the dip and intensity. The only part of the system which has been in partial operation, is that of the variation or declination instrument; and in this, the glass cylinder which supports the sensitive paper, and which is needed to render the record more perfect, is wanting.

An attempt was made to supply this deficiency by means of a copper cylinder, coated with gold by the electrotype process. It was found, however, that the porosity of the gold allowed the acid to act upon the copper below, and thus to produce stains upon the paper. It is hoped this observatory will be fully equipped in the course of the present spring, and that a continued record will hereafter be kept up.

It was mentioned in the last report, that a set of instruments had been furnished the Grinnell expedition under command of Dr. Kane. No intelligence, however, has yet been received from this expedition; but should our most anxious hopes be realized in reference to this enterprise, we doubt not a series of results will be obtained which will well repay the cost of the instruments. If not, the Institution should receive some degree of commendation for aiding in an undertaking which reflects so much honor on the intelligence and liberality of one of our citizens, and the gallantry and enterprise of a young officer of our navy.

Four complete sets of instruments have been constructed in London for the Institution; three of these have been purchased by the general government, and have been employed in the different surveying expeditions. The fourth has been lent, in succession, to different individuals, for the purpose of accumulating magnetic observations in different parts of the United States.

A simple instrument for determining the minute changes in the direction of the magnetic needle, devised by Mr. J. E. Hilgard of the United States Coast Survey, is now in the process of construction, under the direction of this Institution, for the Academy of Natural Sciences, California. The cost of this instrument is defrayed by the liberality of the President of the Academy, Dr. A. Randall.

Observations continued for a certain time at different periods along the coast of the Pacific, and compared with the photographic records obtained by the apparatus in this Institution, would afford interesting results as to the simultaneous perturbations of the magnetic force at distant places on the same continent.

Under the head of magnetism, it may be mentioned that a complete set of apparatus has been obtained from Ruhmkorff, of Paris, for exhibiting the facts of the new branch of science called dia-magnetism. A few years ago, but four metals were known to possess magnetic properties, namely, iron, nickel, cobalt, and manganese. It is now known that all bodies exhibit analogous phenomena when placed under the inductive influence of powerful magnets; but they are not all similarly affected. All bodies may, however, be divided into two classes: one in which polarity is developed at the extremities of a bar of the substance, as in the case of iron, and hence called simple magnetic bodies; and the other class, in which the polarity is transverse to the length of the bar, and the substance is hence called *dia-magnetic*. The simple repetition of these experiments in this country is of importance, and the apparatus may serve as a model for imitation to our ingenious artists.

(3.) On the 26th of last May, the central track of an annular eclipse passed over the northern part of the United States. The eclipse itself was visible over almost the entire area of the North American continent; and as no obscuration of the sun of equal magnitude would again occur in this country until 1865, it was important that all the facilities possible should be afforded for observing its different epochs and phases, as well as the concurring phenomena. For this purpose, in conjunction with the superintendent of the Nautical Almanac, a large map, exhibiting the times of beginning and ending, and the amount of obscuration and phases of the eclipse for every part of the United States, Canada, and Mexico, together with tables and explanations, were prepared and distributed to all the observers in correspondence with the Smithsonian Institution. A set of minute instructions, published under the direction of the American Association for the Advancement of Science, was also presented to the same persons. Unfortunately, the weather proved cloudy over a considerable portion of the space covered by the central part of the shadow, though a number of interesting observations were made. The expense of the map and tables were defrayed jointly by this Institution and by the appropriation for the Nautical Almanac.

The results of the observations, so far as they have been reported, have been published in the Astronomical Journal, edited by Dr. B. A. Gould, jr., Cambridge, Massachusetts. They are illustrated by photographic impressions of the sun, made under the direction of Professor Bartlett, at West Point, and also by others, made under the direction of Professor S. Alexander, of Princeton, New Jersey. The expense of these was borne by the Institution, for which full credit has been given.

I may mention in this connexion that Professor Coffin, of Lafayette College, Pennsylvania, has presented to the Smithsonian Collections an interesting map, on which are delineated the paths or central tracks of all the great solar eclipses of the nineteenth century which traverse the

United States. These are nine in number. Seven of them have passed; the first of the remaining two will occur in October, 1865, and the other in August, 1869.

There are but two journals exclusively devoted to astronomy now in existence. The first is published at the expense of the King of Denmark, and the second in Cambridge, Massachusetts, by Dr. B. A. Gould, jr. The latter is intended to give the earliest intelligence of astronomical discoveries—particularly those made in our own country. At the last meeting of the British Association, the president commended this publication, and expressed a wish that it might be continued. I regret, however, to say that though no branch of science is cultivated with more ardor and success at the present time in the United States than astronomy, yet this work, so essential to its continued progress, is very inadequately sustained. Not only the labor of conducting it has devolved upon the editor, but also a considerable portion of the expense of its publication. The Smithsonian Institution has, from the first, subscribed for a number of copies, to be distributed among its foreign correspondents, and, rather than suffer so meritorious a work, which does so much service to the cause of science and credit to our country, to be discontinued, it might be well to enlarge the subscription. It is to be hoped that, in due time, donations and bequests will be made by liberal individuals for the support of scientific enterprises of this character.

It is gratifying to learn that $10,000 of the Appleton bequest have been devoted to the publications of the American Academy, and an equal sum to those of the Historical Society of Massachusetts; and we may venture to ask whether there are not, in this country, wealthy individuals who can properly appreciate the importance of the labors of Dr. Gould, and establish his journal on a permanent foundation.

(4.) *The laboratory of the Institution*, during the past year, has been used by Professor J. Lawrence Smith in the examination of American minerals; and, on behalf of the Treasury Department, in investigations relative to the different kinds of molasses imported into this country. He also made a series of analyses of meteorites, among which were fourteen specimens belonging to the cabinet of James Smithson, the founder of this Institution.

An extensive series of experiments have been made during the last year, and are still in progress at the Institution, under the direction of a commission appointed by the Secretary of War, consisting of General Totten, Professor Bache, and myself, for testing the materials employed in the extension of the capitol. For the purpose of these investigations, we have employed the beautiful and ingenious machine invented by Major Wade, late of the United States army, which is so contrived as to give in pounds per square inch of the material, the resistance to crushing, to twisting, and to longitudinal and transverse fracture. The materials have been selected and prepared under the direction of Captain Meigs, superintendent of the capitol extension; and the details of the manipulations and calculations have been entrusted to Mr. William Shippen.

The commission has taken advantage of this opportunity to extend the experiments to a number and variety of other building materials

submitted to them from different parts of the United States; and they hope to be allowed to extend their inquiries until they also embrace the comparative strength of the most important articles used in the arts. For example, it is of great practical importance to know the relative and absolute strength of cordage, and the various textile fabrics manufactured by different processes from the raw materials produced in different countries. No complete series of experiments has ever been made upon the strength of the varieties of American timber. Enquiries, however, of this kind involve much labor and considerable expense, and can only be properly carried on by the aid of the government

(5.) *Meteorology.*—During the past year valuable additions have continued to be made to our meteorological collections. Though changes have taken place in the individuals, the number of the observers reporting immediately to the Institution is about the same as that given in the last report. A considerable number of full sets of standard instruments, made under our direction by Mr. JAMES GREEN, of New York city,* have been procured by observers, and the character of the meteorological returns has consequently continued gradually to improve in completeness and precision. The records we have collected now form a copious store of valuable materials for the solution of many interesting problems relative to the meteorology of this country, which have been resorted to by several original investigators for data necessary to their researches. But to render these materials more generally available for the advancement of science, it is desirable to reduce them to tabular forms, and to publish them in as much detail as our funds will allow. In this way the greatest number of persons will have an opportunity of submitting them to the inductive process, by which general laws are deduced from particular facts. There is no part of physical science in which so much is to be done, even in the way of partial generalization, as in meteorology; and hence the importance of engaging as many minds as possible in its investigation.

It is the policy of the Institution to furnish all the means in its possession to aid scientific research, and not to hoard up its treasures or confine their use to those who may be immediately connected with the establishment, or who may be supported by its funds. *Co-operation*, and not *monopoly*, is the motto which indicates the spirit of the Smithsonian operations. It is with this view that I have been anxious to have the materials in our possession reduced to a form for publication; and, indeed, it has been a source of much solicitude that we have not been able before this time to present to the observers the means by which they could compare the results of their records with those of others in different districts. Few persons, however, are aware of the labor, chiefly of a mechanical character, required to tabulate materials of this kind, and the cost of printing them in sufficient fullness of detail to render them generally applicable to scientific or economical purposes. Besides this, I regret to inform the Board that our attempts in the line of reduction have thus far not been successful. I employed for this purpose a person who seemed to possess all the requisite qualifications, and who engaged in the work with commendable industry and apparent

* No. 422 Broadway, New York.

enthusiasm; but, I am sorry to have to say that before the work was completed, he set up such claims to a personal right of property in it, and to a control over the manner in which it should be prepared and published, as were entirely incompatible with the rights of the Institution, and with a due regard to its reputation. I was, therefore, obliged, after many attempts to induce an opposite course, to place the work in other hands. The reductions are now entrusted to Professor COFFIN, of Lafayette College, Pennsylvania, the author of the memoir on the winds of the North American continent; and from his established reputation for scrupulous exactness and punctuality, as well as for intellectual and moral qualities, we may confidently expect to have at least one part of the work ready for the press before the next session of the Board of Regents.

The materials collected consist of two classes, viz: one which includes all the records of observations published in books and periodicals, or contained in manuscripts which have been lent us for reduction; and the other consists of the current observations, which now embrace all the returns we have received for several years past. The reduction of the first class, on which we have expended much money, was, I supposed, nearly ready for the press; but, on examination, it has been found necessary to subject the whole to a careful revision, in order to correct the errors in it which a critical examination has brought to light.

It may be well to state, for the information of the public, that the appropriation which was made for the purchase of instruments to distribute among observers has been exhausted, and that the experiment was not as successful as could have been wished. A considerable number of the instruments were broken, and but comparatively few returns have been received. It does not, therefore, appear advisable to renew the appropriation with the portion of our income which can at present be devoted to meteorology.

Blank forms are furnished liberally to individuals who may desire to record the changes of the weather, or the progress of periodical phenomena.

In order to prevent difficulties similar to those which have heretofore occurred, it is important to state that all communications on the subject of meteorology—and, indeed, on the general business of the establishment, should be addressed to the "Secretary of the Institution." He alone is responsible to the Regents; and it is, therefore, necessary that he should have full knowledge and control of the correspondence.

EXCHANGES.—The system of international exchange has been conducted with very important results during the last year. The additions to the library from this source exceed considerably, in number, those of any previous year; amounting, in the aggregate, to over three thousand volumes and parts of volumes. Many of these consist of expensive works published by governments or institutions in Europe, and such as are not found in any other library in this country. It will not be extravagant to estimate the value of these returns at three thousand dollars; since most of them are the current volumes of the year, and bear the high price of scientific periodicals.

As mentioned in previous reports, the Smithsonian Institution acts as the principal medium of communication between the scientific and literary associations of the old and the new world. During the past year

the number of the societies availing themselves of the facilities thus offered has largely increased, including, among others, nearly all the State agricultural societies of America, publishing transactions. This result has been produced by a circular which was issued by the Institution, early in the spring of last year, to make known more generally the system of exchange. Copious returns are being constantly received for the societies; and an intercourse is thus established which cannot fail to produce important results, both in an intellectual and moral point of view.

The governments of England and France have for some time admitted the packages of the Institution free of duty and without examination. A request for a similar favor was made to the Prussian government, during the past year, and it has been liberally granted by the commissioners of the Zollverein. There is, therefore, no port to which the Smithsonian parcels are shipped where duties are charged on them—a certified invoice of contents by the secretary being sufficient to pass them through the custom-house free of duty. On the other hand, all packages addressed to the Institution, arriving at the ports of the United States, are admitted, without detention, duty free. This system of exchange is, therefore, the most extensive and efficient which has ever been established in any country. Its effect on the character and reputation of our own country can scarcely be too highly estimated; while its influence, though silent, is felt in every part of the globe where literature and science are cultivated.

LIBRARY.—A difficulty which occurred between the librarian and myself has led to his separation from the Institution; and, since the 10th of last July, I have given the library, as far as my multiplied duties would allow, my personal supervision. With the assistance of Professor Baird and others, means have been devised for improving its condition and for rendering it more available for consultation. At present it is not thought advisable to appoint a special bibliographer, but to endeavor to conduct the business of the library by means of the assistants now employed, and by such temporary help as may be found necessary. An assistant has been employed to make a catalogue of all the books received by exchange, and to prepare the volumes and parts of volumes for binding. The list is now complete and will be appended to the next report to Congress, for the purpose of pointing out to our correspondents the deficiencies in the sets of transactions, and thus affording the opportunity to supply them. What we cannot procure in this way we shall endeavor to supply by purchase.

I have also directed that the statistics of the library should be kept, namely, the number of different persons who come to read, and the number and character of the books they call for. During the last six months 150 different individuals have read or consulted 742 books in the library; of these 400 were works of light literature, belonging to the copyright deposit. During the same period 2,576 names were entered in the registry of visitors. The principal value of the library has been to the officers of the Institution, and to other persons engaged in research connected with the Smithsonian publications. These, during the period above-mentioned, have drawn out of the library 450 volumes, principally of a scientific character.

The reading room of the library receives the leading periodicals of this country and Great Britain, together with a number from France, Germany, &c.; and, therefore, offers desirable facilities for the reading community of Washington, and for those who visit the seat of government, to keep up with the general progress of knowledge; while by means of the more profound transactions of learned societies the student is afforded the opportunity of becoming acquainted with the advances made in special branches of literature and science.

Very erroneous ideas have been entertained as to the amount which has been expended on the library. It is true the whole sum directly paid for books has not exceeded $14,139 16; but this does not include the binding, the transportation, the superintendence, and all the other expenses connected with an establishment of this kind. Neither does it exhibit the value of the books procured by exchanging the publications of the Institution for the current volumes of learned societies, or the cost in clerk hire and postage of the books received from the copyright system. The whole expenditure on the library and operations connected with libraries, including a proportional part of the general expenses since the beginning of the Institution, is $71,429 45. To this should be added at least $130,000 for the cost of the part of the building devoted to the library, and we shall then have an expenditure of the income of the Smithsonian bequest on the library and objects immediately connected with it of about $200,000.

In the original programme of organization, a proposition was introduced by Professor Bache to render the Institution a centre of bibliographical knowledge, to which students in every part of the country could apply, by letter or otherwise, for information as to what books existed on a particular subject, and in what libraries they could be found. For this purpose a large number of works on bibliography have been obtained, and efforts have been made to procure copies of all the catalogues of libraries in this country. To facilitate the answers to enquiries relative to the places where particular books could be found, it was proposed to secure three copies of each catalogue, one to be preserved in its original form, and the other two to be cut up, in order that the titles on each side of a leaf could be pasted on cards, and the whole arranged in drawers so as to form a general catalogue. Considerable progress was at one time made in this work, and several thousand cards were prepared by a bookbinder.

It was, however, stopped in order to prosecute the system proposed by Professor Jewett, namely, that of forming a general catalogue of libraries by means of stereotyping separate titles. It appears to me, however, that the first plan ought to be carried out as far as possible, particularly in regard to collecting catalogues; and these should not be confined to those of the libraries of the United States, but embrace, as far as practicable, those of the libraries of Europe. It may happen that an extract may be required by a student from a book not to be found in this country, and that this can be effected through the correspondence of the Institution, provided the location of the work in Europe is known.

About three years ago a series of experiments were undertaken at the expense and under the direction of the Institution for improving and applying a new method of stereotyping. The right to use the process

was purchased of the original inventor, but it was not found in a condition to be applied, particularly to stereotyping catalogues, and in order to improve it an artizan from Boston was employed under the immediate direction of the librarian. The experiments were successful, and the improved process has been employed by Mr. John C. Rives in printing the Congressional Globe. I was anxious that it should be generally applied, in order that the art might not depend on the contingency of the life or will of a single individual. Besides this, should the process be generally introduced, the use of it for the Institution could be more cheaply procured by contract than by attempting to do our own work by a separate establishment in the building. I have, however, just learned that a patent has been applied for, in the name of the artizan before mentioned, for the very improvements which were made at the expense of the Smithsonian fund. This act, though it may be in accordance with the usages of employees under the government, is not, in my judgment, compatible with the liberal spirit of the will of Smithson. While due credit and proper remuneration should be given to any employee for his labors, the results should redound to the reputation of the Institution and to the general good of the public. This remark is also especially applicable to the claims set up by an employee in the meteorological department.

During the past year the process of cataloguing the Congressional library in accordance with the plan adopted by this Institution has been carried on under the direction of Professor Jillson, of Brown University. The whole number of titles catalogued has been 9,654, and of volumes 21,805. The stereotyping of the titles has been suspended for the present, in order to give the workmen who have been engaged on it an opportunity of applying the new art to the printing of the Congressional Globe. It is hoped that an additional appropriation will be made during the present session of Congress sufficient to complete the whole catalogue. We shall then have the statistics necessary to ascertain the cost of preparation of a catalogue of this kind, and the means necessary to give definite information, in reference to it, to the principal libraries of the country.

The edition of Notices of the Public Libraries in the United States, published by the Institution in 1851, is exhausted; and it will be necessary during the present year to collect the materials for a new and enlarged edition. A circular* for this purpose will be issued as soon as possible, and it is hoped that the work will be prepared in time to be submitted to Congress with the annual report for 1855. I have entrusted the duty of collecting the materials for this purpose to Mr. William J. Rhees, who now occupies the place formerly filled by Dr. Foreman, the latter having been appointed to the position of examiner in the Patent Office.

The purchases, though few in number, are of considerable value; and the additions from the system of exchange, as has before been stated, have increased in importance. The articles received on account of the copyright law were more numerous last year than the year before, but not more valuable. 848 separate pieces of music

*A circular distributed by the Institution is given in the Appendix to this Report.

have been received, for each of which two separate manuscript copies of every word of the title page was required. From this single fact it is evident that the operation of the present copyright law does not confer a material benefit upon the Institution, unless it be as a means of swelling the number of articles annually added to the library, which would appear to be at present a matter of some popular importance. It would be well to ask Congress, at least, to relieve the Institution from the burden imposed upon it by the additional postage to which we are constantly subjected on this account.*

The additions to the library during the year 1854 are shown by the following table:

	Books.	Pamphlets and parts of vols.	Engravings.	Maps.	Music.	Drawings.	Other articles.	Total.
Purchase	529	391	......	......	......	......	......	920
Donation and exchange	920	2,397	1	323	......	1	......	3,642
Copyright	441	203	16	28	848	5	69	1,610
Deposit	......	......	......	......	......	......	......	......
Total	1,890	2,991	17	351	848	6	69	6,172

If we add these to the number given in the report of the librarian last year, we shall have the following—

Aggregate to 1855.

	Books.	Pamphlets and parts of vols.	Engravings.	Maps.	Music.	Drawings.	Other articles.	Total.
Purchase	4,961	2,902	1,335	2	......	......	......	9,200
Donation and exchange	4,821	7,561	59	2,136	......	31	41	14,649
Copyright	3,250	623	54	87	3,122	14	166	7,316
Deposit	873	......	......	......	......	......	......	873
Total	13,905	11,086	1,448	2,225	3,122	45	207	32,038

* Since this was written, Congress has passed an act allowing all copyright publications to be sent to the Institution *free of postage* through the mail. A circular sent to all the publishers in the United States on this subject will be found in the Appendix.

Museum and Collections.—(1.) The principal object of the Smithsonian collection of specimens is to present a full illustration of the natural history of North America. The income is not sufficient to collect and support a miscellaneous museum to illustrate all the branches of the physical geography of the globe. Such an establishment can only be sustained by the general government. Were the Institution to embrace all the opportunities which are afforded it to collect specimens, the cost of transportation alone would soon absorb the greater portion of the sum which can be devoted to this branch of the general plan of operations. We are, therefore, obliged to limit our exertions, and to direct them to objects which are more immediately necessary in facilitating certain definite lines of research, and to leave to other institutions the collection of such materials as may be required to make up the complement of specimens necessary to represent the mineral and organic products of our continent.

During the last year, the additions to the museum have been more numerous and valuable than in any previous period of the same extent. Much has been done by parties aided more or less by the Institution, and much by persons in an individual and independent capacity.

The Institution has taken charge of the arrangement and preserservation of all the specimens obtained by the various expeditions of the government; but, as these embrace all objects of natural history, they would scarcely fall within the plan of a special museum. The principal aim, therefore, in taking charge of all the specimens is not to swell the Smithsonian collection, but to preserve them from destruction, and to render them immediately available to science, with the hope that Congress will, at some future day, make a liberal appropriation to support a national collection, of which these will form the nucleus.

In order to carry out the general policy of the Institution, a liberal distribution of the duplicate specimens should be made to societies and other establishments in this country and abroad. During the past year something has been done in this line; and when the collections are properly arranged, and the number of duplicates ascertained, the system of distribution may be so extended as materially to affect the progress of natural history in this country and the world. But the amount of good which may be done in this way must again be limited by the portion of the income which can be expended for this purpose; due regard being had to the claims of all branches of knowledge, of which this is but one.

The primary object of the establishment being kept constantly in view, the specimens in all cases will be open to the use of individuals who may desire to increase knowledge by original research; and the only condition which will be required to be strictly observed is that full credit be given to the Institution for the facilities which it may afford.

No branch of the operations of the Institution can be carried on without the expenditure of a greater amount of labor than might, at first sight, appear to be necessary. Some idea of that required to attend to the specimens added to the museum may be obtained from the fact that over 360 different lots, consisting of barrels, kegs, cans, boxes,

&c., besides many single specimens, have been received during the last year. All these had to be assorted, labelled, and recorded in books, and in most instances duplicate lists sent to the donors. In the case of smaller animals, large numbers of extra specimens are generally collected, to serve for anatomical investigation, or for distribution and exchange.

(2.) *Achromatic Microscope.*—In the first report of the Secretary it was mentioned that an individual, in the interior of the State of New York, had successfully devoted himself to the study and construction of the microscope, and was able to produce specimens of this instrument which would compete with the best of those constructed in Europe; and that, to do justice to the talents and labor of this person, Mr. Spencer had been requested to construct a microscope of the first quality, to be paid for by the Institution, if a commission appointed to examine it should find it capable of producing certain effects. The artist made a number of instruments which fully satisfied the conditions required by the agreement, but which still fell short of the ideal standard of perfection which existed in his own mind.

He has, however, at length completed a microscope, the performance of which far exceeds that which was anticipated when the proposition was made; and the Institution has thus not only secured a valuable instrument of research, but has assisted in developing the talents and making more generally known the skill of a native artist of surpassing merit. I may mention that Mr. Spencer has associated with himself Professor Eaton, of Troy, New York; and they are now able to supply the increasing demand in this country for this invaluable means of research which, within the last few years, has opened a new world to the physiologist and botanist, as well as to the investigator of inorganic matter.

(3.) *Gallery of Art.*—The Stanley collection of Indian portraits still remains deposited in the west wing of the building. They were removed, however, for a short time for exhibition at the Maryland Institute, Baltimore, and the State Agricultural Fair at Richmond, Virginia. They have constantly excited much interest, and it will be a subject of great regret if means cannot be procured to preserve entire a series of portraits which has been produced at so much labor and cost, and which is so faithful a representation of the peculiar physiognomy and costume of the different tribes of Indians now found within the boundaries of the territories of the United States. Mr. Stanley was engaged as the artist of the Pacific railroad survey under Governor Stevens, and has thus had an opportunity of adding much to his material for enlarging the collection. Since it was first deposited in the Institution he has also added to it portraits of several individuals belonging to the Indian delegations which, within the last two years, have visited Washington.

(4.) Professor Wilson, of the British Commission, appointed to attend the Exhibition at the New York Crystal Palace, presented to the Institution, in behalf of the London Society of Arts, a collection of models, drawings and instruments, to facilitate instruction in the art of design. In order to render these immediately useful, they were lent to the School of Design, which has been established in this city by the Metropolitan

Mechanics' Institute, under the charge of Professor Whitaker; and they are still in possession of this society, and are not only valuable on account of the immediate use to which they are applied, but also in serving as patterns for imitation for other schools of a similar character.

The Institution possesses, as has been stated in a previous report, a valuable collection of engravings by the first masters; but these have, from the first, been deposited in drawers, and have therefore not been accessible to the general visitor. It may be well, if the expense is not too great, to have them placed in groups, under glass, in large frames, and thus exhibited to all.

Building.—The main building of the Smithsonian Institution is at length completed. During the last six years, the wings, the connecting ranges, and the apartments in the southern tower, have alone been occupied. The unfinished condition of the edifice has undoubtedly produced an unfavorable impression on the numerous strangers who visit the city of Washington. The object, however, of the delay, as has been repeatedly stated in previous reports, was, first, that a more permanent building, and one better adapted to the uses of the Institution, might be provided; and secondly, that funds might be saved from the accruing interest to furnish an additional income sufficient at least to defray the annual expense of so large and costly an edifice. Both these objects have been attained. The interior of the building, instead of being constructed of wood and plaster, as was originally intended, has been finished with fire-proof materials; and improvements have been made in the plan first adopted which render the edifice better suited to the purposes for which it was intended. The first story consists of one room 200 feet long and 50 feet wide, which can be divided by a screen into two apartments, one of which may be devoted to the library and the other to the museum. The second story is divided into three spaces, the middle one of which is occupied by the great lecture room, capable of containing 2,000 persons, and constructed on acoustic and optical principles. It is believed that this room is the most perfect of its kind in this country, and that it will serve as a model for apartments of a similar character. The spaces adjoining the lecture room east and west form rooms each fifty feet square, which may contain cases around the walls for apparatus and other collections of objects of art, and at the same time serve for meetings of societies or for lectures to smaller audiences on special subjects. On the north side of the lecture room, in the front towers, are rooms intended for the preparation of the experimental illustrations of lectures, but which may be used as committee rooms, while the large lecture room serves for the more public addresses and exhibitions.

The object kept in view in all the changes which have been made in the original design of the building is its adaptation to purposes of general interest, and particularly to the accommodation of conventions and associations intended to promote knowledge or improve the arts of life.

During the past year a number of societies have availed themselve of the facilities afforded by the Institution, and have held their session in the Smithsonian building. The first was the United States Agricultural Society, which continued its session for three days, with lectures

in the evening. It was attended by delegates from almost every part of the United States, and has published a journal of its proceedings, in which due credit is given to the Institution.

The second was the American Association for the Advancement of Science, which met the last of April and continued in session until about the 10th of May. Special preparation was made for this association; and although the building was still in an unfinished state, it is believed the members were well satisfied with their accommodation, as well as the hospitality and attention they received from the President and officers of the general government.

The third was the Association of Medical Superintendents of Hospitals for the Insane, which continued in session several days. The subjects discussed were not only of much importance relative to the treatment of diseases of the mind, but also of interest to the psychologist. Some, too, were of a practical character, connected with the general economy and management of public institutions. The subjects of heating and ventilating were fully discussed.

The fourth was the meeting of the American Association for the Advancement of Education, which has just closed its session. The Smithsonian Institution is thus assisting to render the city of Washington a centre of literary and scientific association, which may serve to diversify its character as the political metropolis of the nation.

LECTURES.—In conformity with the law of Congress, a series of lectures was given during the winter of 1853–'4, and the experiment was made of establishing a full course on a single subject, namely, of chemistry. This was given by Dr. J. Lawrence Smith, late of the University of Virginia, and now professor of chemistry in the Louisville Medical College. The interest in all the lectures was fully sustained until the last.

A number of lectures were also given before the Mechanic's Institute and the Young Men's Christian Association in the Smithsonian lecture room.

The following is a list of the lectures given, with the names of the gentlemen by whom they were delivered.

A course of three lectures by Benjamin Hallowell, of Alexandria, Virginia.

1st. The general principles of astronomy, with the movements and consequent phenomena of the bodies of the solar system.

2d lecture. The sun, Neptune, the asteroids, and comets.

3d lecture. Fixed stars, nebulæ, and stellar systems.

A course of three lectures by Professor C. W. Hackley, of Columbia College, New York. Subject: History of institutions of learning and science.

A course of two lectures by W. Gilmore Simms, esq., of Charleston, South Carolina. Subject: The moral character of Hamlet. Also two lectures for the Young Men's Christian Association, on poetry and the practical.

One lecture by Professor W. J. Whitaker, of Massachusetts. Subject: Method of teaching the art of design.

A course of three lectures by Park Benjamin, of New York. Sub-

jects: 1st. Fashion; 2d. Americanisms; 3d. Intellectual and social amusements.

One lecture by W. G. Dix, of Cambridge, Massachusetts. Subject: The Andes and Ecuador.

A course of twenty-two lectures by Professor J. Lawrence Smith, of the University of Virginia.

1st. The importance of the study of chemistry, and its close connexion with the progress of the arts and manufactures of the present age; also general notice of the nature of bodies, more especially gaseous bodies.

2d. The elements of the atmosphere: oxygen, nitrogen, and ozone, or oxygen in its allotropic condition.

3d. The physical properties of the atmosphere: its weight, color, elasticity, &c.

4th. The compounds of nitrogen and oxygen.

5th. Sulphur and some of its compounds.

6th. Sulphuric acid and its applications. Phosphorus and phosphoric acid.

7th. Chlorine, its applications in the arts and its combination with oxygen. Iodine and its uses, with a notice of its application in the photographic art.

8th. Some of the compounds of chlorine and iodine, bromine, hydrogen, and its application to æronautics.

9th. Compounds of oxygen and hydrogen; the oxyhydrogen blowpipe and the Drummond light; water in several of its relations.

10th. Combinations of hydrogen with nitrogen, sulphur, phosphorus, and chlorine.

11th. Carbon under its various forms of diamond, charcoal, and mineral coal; the combinations of carbon and oxygen.

12th. The agency of carbonic acid in forming incrustations of carbonate of lime; the respiration of plants and animals; the formation of coal-beds and the composition of coals; carbonic oxide and some of the compounds of carbon.

13th. Compounds of carbon and hydrogen; explosions in coal mines; Sir Humphrey Davy's lamp; combustion.

14th. On the phenomena of combustion and ebullition.

15th. On the phenomena of illumination, with an exhibition of every variety of illumination, from a candle to the electric light.

16th. On the phenomena of illumination, with illustration of every form of artificial illumination; an account of the construction and principle of the Fresnel light used in light-houses.

17th. On the ebullition and congelation of water, with a short account of the application of the vapor of water as a motive power.

18th. The conversion of water into steam; its application as a motive power, with some remarks on the explosion of boilers; an account of some of the vapors and gases proposed as substitutes for steam as motive power.

19th. General properties of the metals; potash and soda, with an account of their applications to the arts of glass and soap making, &c.

20th. On the compounds of lime, alumina, and silica, with their applications.

21st. On some of the properties of gold, silver, mercury, and lead, with the manner of their occurrence in nature.

22d. On the properties of copper and iron, with the manner of their occurrence in nature; on meteoric iron and meteorites.

From the foregoing account of the transactions of the past year, it must be evident to every intelligent and unprejudiced person that the Institution has perseveringly continued its course of usefulness, and that, although some of its operations are not of a character to attract public attention or elicit popular applause, yet they are eminently productive of the benevolent results intended by the bestower of the bequest. From the report of the Executive Committee, it will be seen that the funds are still in a good condition; although, on account of unforeseen difficulties in the completion of the building, and of the unexpected rise in the price of labor and material, a larger draft has been made upon the extra fund than was intended. This can be made up, however, if thought necessary, in the course of a few years, by means of the interest which will accrue from the same fund.

It is evident that the collections of books and specimens have increased as rapidly as is consistent with the best interests of the Institution. Every addition to these collections increases the cost of attendance and supervision, and therefore must, with a fixed income, tend to diminish the power of acquisition; and when it is recollected that the Institution is, theoretically at least, to be perpetual, it will be evident that we should be more solicitous in regard to the quality of articles than to their number or quantity. Though these views may not commend themselves to all, I believe they will be found to meet the approval of a large majority of the intelligent community.

In order to preserve the continuity of the history of the Institution in the annual reports of the secretary, it is necessary to allude to the fact that during the past year internal difficulties and changes have occurred which have given rise to a series of attacks on the policy and management of the Institution; but however painful occurrences of this kind may be to those immediately concerned, yet they seem almost inevitable in the first organization of an establishment where precedence is wanting, and where experience furnishes no instruction. They had their origin in the want of a definite recognition of the responsibilities and consequently of the powers of the secretary.

It is evident there can be no efficient action in an Institution of this character without entire harmony of views and unity of purpose, and these can only be secured by one executive head. The Regents have settled this principle, and thus removed all cause of future difficulty of a similar character.

JOSEPH HENRY,
Secretary of the Smithsonian Institution.

JANUARY, 1855.

APPENDIX TO THE REPORT OF THE SECRETARY.

REPORT OF THE ASSISTANT SECRETARY.

SIR: I beg leave to present herewith a report for the year 1854 of operations in such departments of the Smithsonian Institution as have been particularly entrusted by you to my care.

Respectfully submitted,

SPENCER F. BAIRD,
Assistant Secretary.

To JOSEPH HENRY, L.L. D.,
Secretary of the Smithsonian Institution.

1. PUBLICATIONS.

The sixth volume of Smithsonian Contributions to Knowledge, although for the most part printed in 1853, was not published and distributed until the present year. The seventh volume, to consist mainly of Lapham's Memoir on the Ancient Remains of Wisconsin, is in hand, though delayed somewhat by the failure of the contractor to supply paper. The plates, over sixty in number, are nearly all lithographed and printed, and the numerous wood-cuts engraved. The paper, by Professor Bailey, on new microscopic organisms, with one steel plate, has been printed and distributed to microscopists in advance of its appearance in the full volume.

The octavo publications during the year are as follows:

Eighth annual report of the Board of Regents of the Smithsonian Institution, pp. 310.

On the construction of catalogues of libraries, and of a general catalogue. Second edition, pp. 96.

Directions for collecting, preserving, and transporting specimens of natural history, prepared for the use of the Smithsonian Institution. Second edition, pp. 28.

List of foreign institutions in correspondence with the Smithsonian Institution, pp. 20.

List of domestic institutions in correspondence with the Smithsonian Institution, pp. 16.

a—FOREIGN EXCHANGES.

The following table exhibits the statistics of the sixth transmission of packages to Europe, made by the Institution in June, 1854.

The circular issued by the Institution early in the spring, offering its services to the scientific societies of the country, in the transmission of packages to Europe, was eagerly responded to by a large number. The rules requiring that all parcels be delivered free of cost in Washington, that each one be legibly addressed with the name of the donor, and that a separate invoice be sent by mail, or apart from the packages, were pretty generally complied with. It is to be regretted, how-

ever, that the last named regulation was not observed in some instances, thus greatly increasing the labor of the officers in charge, by rendering it necessary to make a transcript of the titles from the bundles themselves.

Such publications as were sent without specific addresses were distributed as appropriately as the information in possession of the Institution allowed.

The boxes containing the packages enumerated in the list, left the Institution towards the end of June, and, having been shipped by packet, did not reach their European ports until some time in September. They were immediately unpacked by the agents of the Institution, and the parcels distributed, with the accompanying circulars, to their respective addresses. Acknowledgments for many of them have already been received.

A.—Table showing the amount of printed matter sent abroad in 1854 by the Smithsonian Institution.

1. *Distributed by Dr. J. G. Flügel, Leipsic.*

COUNTRIES.	Addresses of principal packages.	Addresses enclosed in the preceding.	Total of addresses.	Number of principal packages.	Packages enclosed from American institutions.	Packages enclosed from other parties.	Total of packages.	Weight of boxes.	Number of boxes.
Sweden	8	19	......	15	41	22	......	......	....
Norway	3	2	......	5	13	3	......	......	....
Iceland	1	......	......	2	7	......	......	......	....
Denmark	4	11	......	9	33	13	......	......	....
Russia	16	9	......	29	73	13	......	......	....
Holland	9	11	......	19	61	14	......	......	....
Germany	97	110	......	142	209	112	......	......	....
Switzerland	11	17	......	18	42	21	......	......	....
Belgium	9	12	......	13	45	16	......	......	....
Total	158	191	349	252	524	214	990	4,875	22

2. *Distributed by Hector Bossange, Paris.*

COUNTRIES.	Addresses of principal packages.	Addresses enclosed in the preceding.	Total of addresses.	Number of principal packages.	Packages enclosed from American institutions.	Packages enclosed from other parties.	Total of packages.	Weight of boxes.	Number of boxes.
France	64	47	......	80	148	47	......	......	....
Italy	28	24	......	37	69	27	......	......	....
Portugal	1	......	......	2	14	......	......	......	....
Spain	4	......	......	5	20	......	......	......	....
Total	97	71	168	124	251	74	449	1,884	6

3. *Distributed through the Royal Society and Henry Stevens, London.*

Countries.	Addresses of principal packages.	Addresses enclosed in the preceding.	Total of addresses.	Number of principal packages.	Packages enclosed from American institutions.	Packages enclosed from other parties.	Total of packages.	Weight of boxes.	Number of boxes.
Great Britain and Ireland...	93	98	191	109	206	108	423	2,013	5

4. *Distributed by other parties.*

Countries.	Addresses of principal packages.	Addresses enclosed in the preceding.	Total of addresses.	Number of principal packages.	Packages enclosed from American institutions.	Packages enclosed from other parties.	Total of packages.	Weight of boxes.	Number of boxes.
Rest of old world..........	18	2	......	19	45	2	......	......	....
South America............	9	......	......	22	26	......	......	......	....
Total..................	27	2	29	41	71	2	114	1,019	5
Grand total	375	362	737	526	1,052	398	1,976	9,791	38

The number of foreign institutions to which full series of Smithsonian publications were sent for 1854 amounted to 263, or five more than the previous year. The list is necessarily subject to considerable variation, new names being added, and others taken off for non-compliance with the regulations of the Institution, or other causes. An acknowledgment of the reception of one package is imperatively required before another is sent, and in the failure to meet this rule, some first class institutions are dropped for one or two years, or until the omission is rectified.

There is no port to which the Smithsonian parcels are shipped where any duties are charged on them, a certified invoice of contents from the Institution being sufficient to carry them through the custom-houses free of duty.

Receipt of books by exchange.—The additions to the library of the Smithsonian Institution, by its exchanges, have been very marked during the year. Attention was called in the last report to the very great increase in our foreign exchanges, in consequence of the extension of the list of recipients of Smithsonian publications. During 1854, the works received have been fully equal in value to those of 1853, containing actually a larger number of pieces, and binding up to a greater number of volumes. The following table exhibits the record of this department. The discrepancy between this record and that of the

library is owing to the fact that the latter included donations from individuals and other sources in this country, which the former did not, and that some separate sheets of maps were all bound together before being placed in the library:

B.—TABLE EXHIBITING THE NUMBER OF PIECES RECEIVED IN EXCHANGE DURING 1854.

Volumes.—Folio and quarto	271	
Octavo	655	
		926
Parts of Volumes and Pamphlets.—Folio and quarto	447	
Octavo	1,021	
		1,468
Maps and Engravings		434
Total		2,828

As was to be expected, a large proportion of receipts by exchanges consisted of the publications of learned societies, many of which, in addition to their current volumes, have sent their back series, either in whole or part. This department of the library is rapidly becoming more and more complete, and is believed even now to exceed that of any other library in the country. The catalogue now in preparation of the publications of societies and periodicals belonging to the Institution will furnish a ready means of indicating what are the desiderata of this nature.

In addition, however, to returns from societies, the receipts from public libraries and universities of duplicates from their shelves have been very numerous, and consisting, as they usually do, of important scientific works, have proved highly acceptable. Owing to the constant communication kept up with the principal men of science at home and abroad, and the transmission to them of such publications of the Smithsonian Institution as related to their specialities, very many valuable memoirs and works have been received in return from this source

In the very great number of large donations received during the year it has been found impossible to give a particular enumeration of them without encroaching too much in the space allotted to me. This is, however, less necessary, as the catalogues now in preparation, and shortly to be printed, will convey full information on the subject.

The following tables contain a statement of the packages received from the various sources specificed, for distribution in Europe as well as those received from Europe for this country:

C.—Table of packages from American institutions for distribution abroad.

Cambridge.—Nautical Almanac	35
Boston.—American Academy of Arts and Sciences	133
Boston Society of Natural History	42
New Haven.—American Journal of Science	47
New York.—New York Lyceum of Natural History	99
American Ethnological Society	19
Philadelphia.—Academy of Natural Sciences	136
American Philosophical Society	116
Philadelphia College of Pharmacy	9
Washington.—United States Patent Office	150
National Observatory	111
Light-house Board	15
New Orleans.—New Orleans Academy of Natural Sciences	300
Columbus, Ohio.—Ohio Board of Agriculture	21
Detroit, Michigan.—Michigan State Agricultural Society	200
Madison, Wisconsin.—Wisconsin State Agricultural Society	143
San Francisco, California.—Geological Survey of California	60
Santiago, Chile.—Observatory of Chili	48
From miscellaneous sources, including individuals, &c	1,132
Total received	2,816

D.—Table of packages received from Europe for distribution to various societies in America.

Canada.—Various Societies	3
Boston.—American Academy of Arts and Sciences	50
Natural History Society	26
Bowditch Library	5
Cambridge.—Observatory	7
Botanic Garden	3
Harvard University	13
Astronomical Journal	12
American Association	13
Worcester.—Antiquarian Society	1
New Haven.—American Journal of Science	37
American Oriental Society	5
Albany.—New York State Library	10
New York.—New York Lyceum of Natural History	11
American Ethnological Society	1
Geographical and Statistical Society	3
American Institute	5
West Point.—United States Military Academy	1
Philadelphia.—American Philosophical Society	47
Academy of Natural Sciences	40
Franklin Institute	1
Geological Survey of Pennsylvania	5

Washington.—President of the United States		1
	State Department	3
	United States Patent Office	12
	Congress Library	7
	Coast Survey	6
	National Observatory	30
	National Institute	3
	Commissioner of Indian Affairs	1
	United States Naval Astronomical Expedition, Chili	15
Georgetown, District of Columbia.—Georgetown College		6
Chicago, Illinois.—Mechanics' Institute		5
Colleges in different places		19
Various State libraries		37
Miscellaneous societies and individuals		543
Total		987

In concluding this portion of my report, I would beg to call your attention to the zeal and fidelity with which the agents of the Institution in London, Leipsic, and Paris, have discharged their duties. The thanks of the Institution are most especially due to Dr. J. G. Flügel, of Leipsic, whose efforts in the great cause of tightening the bonds of union between the literary and scientific men and institutions of the two worlds are beyond all praise.

3.—Domestic Exchanges.

The copies of volume 6 of Smithsonian Contributions were distributed early in the summer, through the agents of the Institution in different cities of the Union, as follows: Messrs. J. P. Jewett & Co., Boston; Geo. P. Putnam & Co., New York; Lippincott, Grambo & Co., Philadelphia; John Russell, Charleston; B. M. Norman, New Orleans; Dr. Geo. Engelmann, St. Louis; H. W. Derby, Cincinnati; and Jewett, Proctor & Worthington, Cleveland. The services of these gentlemen, involving considerable expense of time and trouble, have, in every instance, been given without charge.

4.—Museum.

a—*Increase of the Museum.*

During no period in the history of the Institution have the receipts of specimens been so numerous, or valuable, as in the year 1854. Contributions have been steadily flowing in from widely remote regions, many of which had been previously but little known. Expeditions, both public and private, individuals and societies, have all aided in gathering together what is now confidently believed to be the most valuable collection in the world of many divisions of the natural history of North America. Much has been done by parties aided directly to a greater or less extent by the Smithsonian Institution, and much by persons acting in an individual and independent capacity. The most im-

portant additions have, however, been received from the various government expeditions mentioned hereafter. Many officers of the army, as heretofore, have forwarded more or less complete collections, made in the neighborhood of the posts at which they have been stationed.

The government expeditions by which collections have been made are as follows:

United States Mexican Boundary Commission, under the scientific direction of Major Emory, United States army; General Robert B. Campbell, commissioner. The region illustrated by the collections received consisted of the Rio Grande, from Eagle Pass to its mouth. Under the present organization of the commission, with Major Emory acting as commissioner in addition to his former duties, there is reason to hope for new results of the most important character.

Survey of route for railroad to the Pacific—

A. Northern route, under Governor I. I. Stevens. Region traversed extending from Fort Benton, on the Missouri, to the Pacific ocean.

B. Parallel of 38°, under Lieutenant E. G. Beckwith. From the Arkansas, by way of Fort Massachusetts and Salt Lake, to San Francisco.

C. Parallel of 35°, under Lieutenant Whipple. From Fort Smith, on the Arkansas, via Albuquerque, Zuñi, San Francisco mountains, and the Mohave, to San Francisco.

D. Partial route, under Lieutenant R. S. Williamson. Extending from San Francisco to the Mohave, and Tejon Pass to camp Yuma.

E. Parallel of 32°, under Lieutenant J. G. Parke. Extending from camp Yuma via Tueson to El Paso.

F. Parallel of 32°, under Captain J. Pope. From El Paso, across the head of the Brazos and Colorado, to Preston in Texas.

Exploration of the coast of California, by Lieutenant W. P. Trowbridge, United States army.

Exploration of the La Plata and its tributaries, by Lieutenant Page, United States navy.

A more particular account of these several expeditions will be found in the article on scientific explorations.

From these different expeditions a large number of collections have been received, embracing material of the first importance and interest. Full reports are in preparation, and will be presented to Congress for publication with the other results of the explorations, and with such amount of illustrations as circumstances may require or authorize.

Among the more private explorations, from which results of the greatest importance have been received, are those of Dr. P. R. Hoy, in Missouri; Reverend A. C. Barry, in Wisconsin; Gustavus Wurdemann, in Louisiana; Lieutenant H. G. Wright, at Garden Key, Florida; Robert Kennicott, northern Illinois; Dr. L. A. Edwards, Fort Towson, &c.; together with my own, on the Jersey coast. Further accounts of these will be hereafter given.

In view of the vast multitude of objects received during the year, it is manifestly impossible to give full details respecting them; and I can here only refer to this subject in the most general manner, taking up the collections in the following order:

Mammals.—A specimen of the so-called Sampson fox, a peculiar va-

riety of the red fox, or *Vulpes fulvus*, was received from Dr. Ackley and Dr. Kirtland, of Cleveland. Various kinds of *Sorex*, and other small mammals, from Reverend Chas. Fox, of Grosse Isle, Michigan.* The fœtus of a whale, from the arctic regions, was presented by Lieutenant Maury. The fresh skin and horns of a fallow deer (*Cervus dama*), and elk (*Elaphus canadensis*,) by Colonel Tuley, of Clarke county, Virginia, whose extensive park contains many fine specimens of these species. A pair of living wild cats (*Lynx rufus*,) were sent by Dr. Evans through Dr. D. D. Owen. The most important additions, however, have been received from Lieutenant Trowbridge, collected on the Pacific coast, including skins of deer, wolves, foxes, hares, lynxes, &c., with many small mammals. In this collection are several new species of hare.

Birds.—A very large collection of the birds of California was received from Lieutenant Trowbridge, embracing nearly all of the larger aquatic species of the coast, and another from Mr. Cutts. A collection of over 100 skins, from Gustavus Wurdemann, at Calcasieu, Louisiana, included several very rare and new species. Dr. Brewer presented some specimens from Wisconsin, and Mr. William M. Penrose an albino blackbird from near Carlisle, Pennsylvania.

Reptiles and fishes.—As usual, it is in this department that the additions have been greatest. The species of Wisconsin have been received from Dr. Hoy and Mr. Barry; of New Jersey and New York, from Mr. Brevoort and myself; of Mississippi, from Colonel Wailes and Reverend Benjamin Chase; of California, from Dr. Newberry, Mr. Bowman, and Lieutenant Trowbridge; of Illinois, from Mr. J. D. Sergeant, Robert Kennicott, and Mr. Harris; of South Carolina, from Professor Holmes, Mrs. Daniel, and Dr. Barker; of North Carolina, from Mr. Bridger, Mr. McNair, and Mr. Lineback; of Louisiana, from Mr. Wurdemann; of Missouri, from Dr. Hoy, Dr. Engelmann, and Mr. Lear; of Alabama, from Mr. Edgeworth; of Minnesota, from Mr. Riggs; of Tennessee, from Professors Owen and Johnson; of Chihuahua, from Mr. Potts; of Gulf of Mexico, from Lieutenant Wright; of Surinam, from Dr. Wyman; of Brazil, from Mr. Austin; of Trinidad and Key West, from Professor W. H. Thomas; of Africa, from Dr. Steele; together with many others. My limited space will not allow me to go into details respecting these collections beyond stating that those of Lieutenant Trowbridge are the most important, adding, as they do, some fifty new species of fishes alone to the North American fauna. Collections of reptiles deposited by Dr. Webb, who procured them in northern Mexico, New Mexico, and Texas, are likewise very valuable.

Quite a large number of living reptiles—snakes, lizards, turtles, &c., were received during the year, but, owing to the want of means for their proper preservation, few survived. Among those, however, at present in apparent good health, may be mentioned a northern rattlesnake (*Crotalus durissus*) from Virginia; the black massasauga, (*Crotalophorus massasauga*,) sent from Ohio by Dr. Kirtland; six specimens of *C. tergeminus*, Say, or prairie rattle, from Illinois, by Robert

*** To this gentleman the Institution has been under very great obligations for numerous specimens illustrating the zoology of Michigan, accompanied, usually, by copious notes on the habits and peculiarities of the species. It is with profound regret that I have to record his death by cholera during the past summer.**

Kennicott; two young alligators from Professor Forshey, Texas; a snapping turtle, *(Chelonura serpentina)* from Mississippi, and various others. Another season will, however, find us better prepared for a great variety of species already promised. Few collections of living animals excite more interest in the spectator than those of reptiles, while the habits of many species, at present unknown, can only be ascertained by their study in captivity. None admit of such confined accommodations, or require so little attendance and food.

Invertebrata.—Marine invertebrata of Jersey, were collected by myself, and of Louisiana by Mr. Wurdemann. A highly interesting and valuable collection made by Mr. Jarvis, inspector of timber in the Portsmouth navy yard, and presented by Commodore Smith, chief of the Bureau of Docks and Yards, illustrates well the growth of the teredo and barnacle, with the real or pretended artificial methods of preventing their ravages. From the experiments of Mr. Jarvis, however, it would seem to be proved conclusively that the white zinc paint, made by the New Jersey Company, as long as the surface covered by it remains unbroken, forms as effectual a protection to a ship's bottom as copper sheathing itself. Nearly all the alcoholic collections received included specimens of astaci and insects from different parts of North America.

Fossils.—Many valuable collections of fossil remains have been received. An interesting series from the vicinity of Satow was forwarded by the Rev. L. Vortisch; Mr. G. Lambert, of Mons, presented a series of carboniferous fossils of Belgium; specimens from Texas were sent in by Lieutenant J. G. Benton, United States army, and by Dr. Julius Froebel; from Panama by Dr. E. L. Berthoud; from Illinois by Dr. Stevens; from North Carolina by Mr. Bridger. A complete set of minerals and fossils of the remarkable brown-coal beds of Brandon, Vermont, was received from David Buckland. Sharks teeth and mastodon bones of Florida, from Captain Casey, United States army; fossil-wood of California, from Mr. Langton, and infusorial earth of Monterey, from Major Barnard.

Minerals.—A valuable collection of specimens illustrating the materials of which some of the principal public buildings in Europe are constructed, gathered by Mr. Evans, was deposited in his name by Lieutenant Gillis, and minerals of New Mexico and Texas were received from Lieutenant Colonel J. K. Mansfield, United States army, and Dr. Froebel; opal of Mexico from Mr. Rogers. A series illustrating the auriferous deposites of Bridgewater, Vermont, was presented by Mr. Cunningham.

Plants.—Some very large collections of plants of the Rocky Mountains and the regions west were brought in by the exploring expeditions. Others were sent from Texas by Dr. Ervendburg, from Minnesota by Mr. Riggs, from Madagascar by Messrs. Cotheal, &c. A very large leaf of the Talipot tree was presented by Commodore Aulick.

Antiquities.—Various specimens of Indian remains in North America have been received during the year from various sources, as also an ancient Peruvian vase from Talcahuana.

b—*Work done in the Museum.*

The labor of receiving, unpacking, and assorting the specimens received during the year has been very great, occupying a large share of my time as well as that of Mr. Girard.

Some idea of the labor involved may be obtained from the fact that in 1854 there were received 35 kegs and barrels, 26 cans, 175 jars, 94 boxes, and 32 packages, all containing a greater or less number of specimens, giving an aggregate of over 350 different lots, without including numerous specimens received singly. All these had to be assorted or repacked, labelled by localities, at least, and recorded in the proper books, and in most cases duplicate lists sent to the donors. We have, however, succeeded without other than mechanical aid in accomplishing all that was immediately necessary to be done, leaving very few arrears for the ensuing year.

Considerable progress has, likewise, been made in the determinations and descriptions of the collections themselves. A number of reports upon the vertebrata of the several explorations, both of the Pacific railroad survey, and of the United States navy astronomical expedition, under Lieutenant Gillis, have been either completed by Mr. Girard and myself or are in an advanced state of progress. The series of descriptive systematic catalogues of the collections has been extended by the preparation of an elaborate account of the North American toads by Mr. Girard, and of the frogs and tree frogs by myself; these are entirely finished and ready for press, and will make a volume nearly as large as the catalogue of North American serpents. Full descriptions of the families, genera, and species of all inhabiting North America (including about 20 new ones) are given, and analytic and exhaustive methods applied to the species. Such catalogues, forming as they do so many manuals in North American zoology, extend the benefits of the museum far beyond its walls. The demand, indeed, for them is so great, from all parts of the world, that of the catalogue of serpents two editions of 1,000 copies each have been called for and distributed.

A good deal of time has also been taken up in the preparation of specimens for examination, cleaning skeletons and skulls, dissecting, &c., while the selection, labelling, packing, and recording of the collections sent from the Institution have created no inconsiderable amount of labor.

In connxtion with the subject of the work done in the museum, it may, perhaps, be proper to refer to the article in the appendix containing the result of my observations on the habits and peculiarities of the fishes of the Jersey coast, as made in the summer, together with descriptions of the colors from life of such species as are apt to fade in spirits.

c—*The present Condition of the Museum.*

The paragraph upon the work done in the Museum covers to some extent the subject of the present heading. No change has been made in the places of deposit of the specimens owing to the very recent

period at which the new hall intended to receive the collections was completed, and this year, it is earnestly hoped, will not pass without an improvement in this respect. The new hall is quite large enough to contain all the collections hitherto made, as well as such others belonging to the government as may be assigned to it. No single room in the country is, perhaps, equal to it in capacity or adaptation to its purposes, as, by the proposed arrangement, it is capable of receiving twice as large a surface of cases as the old Patent Office hall, and three times that of the Academy of Natural Sciences of Philadelphia. In this room, then, there will be abundant opportunity to arrange all the collections which have been made or may be expected for some time to come in the order best suited to the wants of the student and most interesting to the casual visitor. In the mean time, under the conditions of the past year, everything has been done to render the collections as available and accessible as circumstances would allow; all the North American mammalia, amounting to over 500 specimens in skins, have been arranged systematically in drawers of dust and insects-proof walnut cases. The birds have been similarly treated, while the reptiles and fishes (each species from each locality in a separate jar) have been assorted as systematically as the over crowding of the present confined space would allow. During the year several thousand jars have been filled with alcholic specimens, which are illy accommodated on shelves, nearly every square inch of which was occupied at the beginning of the year. The shells of mollusca with the minerals and fossils, have generally been repacked after entry and stored away for the present, requiring as they do a less vigilant supervision. This has, to a certain extent, likewise been done with the plants.

d—*Distribution of Collections.*

In accordance with the spirit of the Institution, quite a large number of specimens, in sets varying in magnitude, have been distributed during the past year to various institutions and individuals desiring them for purposes of special investigation. Some of these may be looked upon in the light of returns for similar favors received or promised, but they have generally been furnished without reference to an equivalent of any kind. As the facilities of the Institution for receiving and properly arranging its collections increase and the duplicates are ascertained, by a proper examination of the specimens, this system of distribution may be carried to an extent that shall materially affect the progress of science throughout this country and the world.

To the investigator who has heretofore been obliged to spend the best years of his life in collecting together the materials of his labor, gathered amid toils and privations to which, in the end, he may be forced to succumb, the advantage of finding all he needs ready to his hand, and in greater extent and variety than he could singly hope to obtain, are beyond all calculation. For this reason it is that the accumulation of a large amount of duplicate material becomes necessary,

in addition to the complete series of specimens to be retained on the shelves.

Among the more important collections thus distributed may be mentioned one of 145 species of North American birds, in 199 specimens, to the Swedish Academy of Sciences at Stockholm, in return for a very valuable collection of skins and skeletons of north European mammalia; 97 species and 160 specimens of North American birds to Mr. F. Sturm, of Nürnburg, in return for collection of birds, &c., from central Europe; 104 lots of fishes and invertebrates to Professor Agassiz, of Cambridge, in return for numerous donations of duplicates from his pre-eminently valuable collection; fishes of Massachusetts to Dr. D. H. Storer, of Boston, to assist him in the preparation of his memoir on the fishes of the State; numerous birds and quadrupeds, both European and North American, to the Philadelphia Academy of Natural Sciences; eggs of American birds to Dr. T. M. Brewer, for his work on North American oology; large numbers of North American coleoptera to Dr. Leconte, for his memoirs on this department of entomology, &c. The list is capable of considerable extension, but there is enough to show how the Institution has endeavored to co-operate with all societies and individuals, engaged in special investigations, requiring materials additional to those already in their possession.

It will, however, be sufficiently evident that the Smithsonian Institution cannot indiscriminately undertake systematic exchange of specimens with other parties—with individuals especially. The force of the natural history department is not now sufficient for this, and may never be. To the mere collector, as distinguished from the investigator, it will not be expedient to distribute specimens to any considerable extent, as the disposable stock may be reduced so low as to render it difficult or impossible to do proper justice to the student. While, however, the Institution cannot undertake the mere business of exchange with individuals, unless in exceptional cases, and even with institutions, it can do and has done much to facilitate such exchange between other parties. Scarcely a week passes without the communication of information of the readiness or desire of exchange in particular departments on the part of different individuals or associations. All notifications or applications of the kind are systematically recorded in the proper books and duly referred to when occasion requires.

LIST OF THE PRINCIPAL DONATIONS TO THE MUSEUM OF THE SMITHSONIAN INSTITUTION DURING 1854.

Professor E. B. Andrews.—Keg of fishes from the Ohio river.

Commodore J. Aulick, U. S. N.—Leaf of Talipot palm (*Corypha umbracaulifera*) from Ceylon.

Joseph B. Austin.—Jar of reptiles from Para.

Spencer F. Baird.—Two kegs and one hundred jars of fishes, and invertebrates, with skins of birds, skulls and teeth of sharks and rays; from Beesley's Point, Cape May county, New Jersey. One keg of fishes from Greenport and Riverhead, Long Island. One keg of fishes from the fresh and brackish waters about Sing-Sing, New York. One keg

of fishes from the Hackensack river and Sparkill, Rockland county, New York.

Dr. S. W. Barker.—Living specimens of *Nerodia erythrogaster*, *Heterodon niger*, *Ophibolus getulus*, and *Elaps fulvus* from South Carolina.

Major J. G. Barnard, U. S. A.—Infusorial earth from Monterey, California.

Rev. A. C. Barry.—Keg of fishes from southern Wisconsin; two kegs of mammals, reptiles, fishes, &c., from northern Wisconsin.

Lieutenant J. G. Benton, U. S. A.—Box of fossils from San Antonio, Texas.

Dr. E. L. Berthoud.—Fossils from the isthmus of Panama. Indian relics and fishes from Bourbon county, Kentucky.

J. S. Bowman and S. M. Bowman.—Fishes and reptiles collected on the route from Salt Lake city to Marysville, California.

C. C. Brevoort.—Fresh specimens of *Esox fasciatus* from Long Island. Fresh specimens of trout and hake from New York. Fishes, in alcohol, from the vicinity of Brooklyn, New York.

T. M. Brewer, M. D.—Skins of birds from Dane county, Wisconsin.

J. L. Bridger.—Stand containing a series of tertiary fossils, with living serpents, *Farancia abacurus*, and two birds, *Ortyx Virginianus*, from Edgcombe county, North Carolina.

David Buckland.—Box of minerals and fossils from the brown coal deposit of Brandon, Vermont.

Captain Casey, U. S. A.—Fossil teeth of mastodon and sharks from Florida.

Rev. Benjamin Chase.—Stuffed *Sternothaerus* from Concordia lake, Louisiana.

Captain Chatten.—Specimens, in alcohol, of *Ophidium marginatum* from Beesley's point, New Jersey.

Charleston College, S. C.—Duplicates of a collection of Batrachia.

Messrs. Cotheal & Co., New York.—Specimens of seeds of silk cotton; leaves, fruit, and manufactured cloth from the Rafar palm, Madagascar. Model of Madagascar canoe.

John P. Cunningham.—Box of minerals illustrating the auriferous deposits of Vermont.

R. D. Cutts.—Skins of thirty species of birds from San Francisco county, California.

Mrs. M. E. Daniel.—Can of reptiles and fishes from Anderson, South Carolina.

Edward T. Denig.—Reptiles and fishes from Fort Union, Nebraska.

T. J. Dryer.—Specimens of minerals from the summit of Mount Hood, Oregon.

J. Eckels, (United States consul, Talcahuana.)—Peruvian vase and ear of corn, disintered near Talcahuana.

A. E. Edgeworth.—Can of reptiles and fishes, with dried plants, shells, &c., from Marengo county, Alabama.

Dr. L. A. Edwards, U. S. A—One box of fossils, one bale of plants, ten jars of reptiles and insects, and various heads and feet of birds, from Fort Towson, Arkansas.

Dr. George Engelmann.—One barrel fishes, reptiles, and mammals from St. Louis.

L. C. Ervendburg.—Package of seeds of Texas plants.

Dr. J. Evans and Dr. D. D. Owen.—Two living wild cats, (*Lynx rufus*,) from the Upper Missouri.

Dr. Julius Froebel.—Box of fossils and minerals from Texas and New Mexico.

Professor Charles Fox.—Skin of shrew, (*Sorex dekayi.*)

Lieutenant J. M. Gilliss, U. S. N.—Specimens of building materials collected in Europe, by W. W. Evans. Deposited.

John Greiner.—Specimens of *Phrynosoma*, in alcohol, from Santa Fé.

Dr. A. M. Grinnan.—Collection of plants from near Fredericksburg, Virginia. Can of reptiles and fish from Madison, Virginia.

J. O. Harris.—Fossils, insects, fishes, and reptiles, from Ottawa, Illinois.

Dr. Henderson, U. S. N.—Jar of fishes from Columbia county, Pennsylvania.

Mrs. Mary Hereford.—Bones of *Zeuglodon*, from a marl bed in Calvert county, Maryland.

Dr. Hereford.—Living specimens of *Leptophis æstivus*, from Prince George's, Maryland.

Dr. P. R. Hoy.—Fishes from southern Wisconsin; keg of fishes, reptiles, and mammals, from Illinois and Missouri; two kegs of fishes and reptiles from western Missouri; reptiles from Mansfield county, Ohio.

Rev. Thomas R. Hunt.—Red shale, with teeth of fishes, from northern Pennsylvania.

R. W. Kennicott.—Two jars of reptiles, fishes, &c., from northern Illinois; box containing six living *Crotalophorus tergeminus*, and other species of serpent, with other reptiles, from northern Illinois.

Dr. W. S. King, U. S. A.—Skins of chaparal cock, (*Geococcyx Mexicanus,*) from San Diego, California.

C. F. Kirtland.—Keg of fishes from Yellow creek, Ohio.

Professor J. P. Kirtland and Dr. Ackley.—Fresh specimen of Sampson fox, (*Vulpes fulvus,*) from Cleveland, Ohio.

Prof. J. P. Kirtland.—Four living specimens of *Crotalophorus massasunga.*

G. Lambert.—Fossils and rocks from Belgium.

W. F. Langton.—Fossil wood and sulphuret of iron, from the Minnesota mines in California.

O. H. P. Lear.—Fishes from Marion county, Missouri.

Major John Le Conte.—Jar of reptiles from Liberty county, Georgia; skin of *Sorex* from Georgia.

J. C. Lineback.—Can of reptiles and fishes from Salem, North Carolina.

Marshall McDonald.—Living specimen of *Scotophis Alleghaniensis*, Alleghany black snake, from Hampshire county, Virginia.

Lieutenant A. McRae, United States navy.—Scorpions and crustaceans from Panama.

J. C. McNair.—Eight jars of reptiles and fishes from Summerville, North Carolina.

R. C. Mack.—Specimens of Zanzibar copal, enclosing an insect and a lizard.

Rev. Charles Mann and *Masters George and William Mann.*—Salamander *(Amblystoma opacum)* with eggs taken in February, 1854. Can of fishes and reptiles from Gloucester county, Virginia.

Colonel J. K. Mansfield, United States Army.—Box of minerals and fossils, collected between Fort Atkinson and Santa Fé, New Mexico.

Hon. George P. Marsh.—Keg of fishes and reptiles with shells, &c., from Palestine, Syria, &c.

Lieutenant M. F. Maury, United States Navy.—Fœtus of right whale, and portion of the skin of sperm whale of 75 barrels, from the North Atlantic.

Professor O. W. Morris.—Young *Menopoma* just excluded from the egg, Holston river, Tennessee.

W. E. Moore.—Skin of humming bird, from the Island of Juan Fernandez.

Dr. J. S. Newberry.—Jar of reptiles from Bodega, California (deposited.)

Professor R. Owen.—Keg of reptiles and fishes from Tennessee.

William M. Penrose.—Skin of albino female of *Agelaius phoeniceus*, shot near Carlisle, Pennsylvania.

Charles Pillichody.—Two cans of fishes from Mobile, Alabama.

John Potts.—Skins of mammalia and reptiles in alcohol, from New Mexico. Skins of *Lepus artemisia* and of several birds, with a can of reptiles and fishes, from Chihuahua.

Alfred L. Riggs.—Can of reptiles and fishes, from Lac qui Parle, Minnesota.

Jeremiah Rogers.—Precious opal from Mexico.

Hon. Sion H. Rogers.—Fossil bone from Roanoke, North Carolina.

Sir R. Schomburgh.—Land shells, from Guiana.

J. D. Sergeant.—Specimens of *Pityophis* and *Eutænia*, from Illinois.

Dr. G. G. Shumard.—Five cans of fishes, one can of reptiles and two boxes of insects, from Fort Smith, Arkansas.

Captain E. K. Smith, U. S. A.—Fishes and reptiles, from St. Augustine, Florida.

Commodore Smith, U. S. N.—Series of specimens illustrating the experiments of Mr. John Jarvis, inspector of timber, navy yard, Portsmouth, Virginia, on the growth and ravages of teredo and barnacle, and means of protection against them.

Dr. Thomas L. Steele.—Four jars of reptiles and fishes, with one *Pteropus*, from Cape Palmas, west Africa.

Dr. R. P. Stevens.—Box of fossils and shells, from Illinois.

Professor W. H. B. Thomas.—Jar of reptiles, from Trindad, and one from Key West, Florida. Skin of *Scalops breweri.*

Lieutenant W. P. Trowbridge, U. S. A.—One keg and can of reptiles and fishes, with two boxes of skins of birds and mammals, skeletons, shells, &c., from San Diego, Monterey, and Presidio, California.

Colonel Joseph Tuley.—Skins and horns of male fallow deer, *Cervus dama*, and elk, *Elaphus canadensis*, from his park in Clarke county, Virginia.

Pfarrer L. Vortisch.—Collections of minerals, fossils, and antiquities, from Satow, Germany.

Colonel B. L. C. Wailes.—Three kegs of fishes, from Mississisippi. Keg of reptiles and fishes, from Washington, Mississippi.

Dr. T. H. Webb.—Reptiles, mammals, insects, &c., from California, New Mexico, and Texas. (Deposited.)

Lieutenant H. G. Wright, U. S. A.—Keg of fishes, from Fort Jefferson, Garden Key, Florida.

Gustavus Wurdemann.—Fishes, reptiles, and invertebrates, from Aransas, Texas, and New Orleans. Box of bird skins, and ten jars of reptiles, fishes, &c., from Calcasieu, Louisiana. Six jars of fishes, &c., from Fort Morgan, Mobile, Alabama. Reptiles, fishes, and invertebrates, Brazos, Texas. Fishes, reptiles, and invertebrates in alcohol, with skins of birds and mammals, from Aransas, Texas.

Dr. J. Wyman.—Can of fishes and reptiles, from Surinam and Guiana.

List of Meteorological Stations and Observers.

State.	Name of observer.	Residence.	County.
Nova Scotia	Henry Poole	Albion Mines	Pictou.
	A. T. S. Stuart	Wolfville, Acadia College.	
Canada	Dr. Charles Smallwood	St. Martin's, near Montreal.	
Maine	George B. Barrows	Fryeburg	Oxford.
	Joshua Bartlett	South Thomaston	Lincoln.
	John J. Bell	Carmel	Penobscot.
	William D. Dana	Perry	Washington.
	Samuel A. Eveleth	Windham	Cumberland.
	Rev. S. H. Merrill	Bluehill	Hancock.
	J. D. Parker	Steuben	Washington.
New Hampshire	Samuel N. Bell	Manchester	Hillsborough.
	Rev. L. W. Leonard	Exeter	Rockingham.
	R. C. Mack	Londonderry	Rockingham.
	Dr. William Prescott	Concord	Merrimack.
	George B. Sawyer	Salmon Falls	Stafford.
	Henry E. Sawyer	Great Falls	Stafford.
	Albert A. Young Prof. Ira Young	Hanover	Grafton.
Vermont	D. Buckland	Brandon	Rutland.
	James K. Colby J. P. Fairbanks	St. Johnsbury	Caledonia.
	Charles A. J. Marsh James A. Paddock	Craftsbury	Orleans.
	D. Underwood	Castleton	Rutland.
	Zadock Thompson	Burlington	Crittenden.
Massachusetts	Lucius C. Allin	Springfield	Hampden.
	William Bacon	Richmond	Berkshire.
	John Brooks	Princeton	Worcester.
	Marshal Conant	Bridgewater	Plymouth.
	Prof. P. A. Chadbourne	Williamstown	Berkshire.
	Emerson Davis	Westfield	Hampden.
	B. R. Gifford	Wood's Hole	Barnstable.
	Amasa Holcomb	Southwick	Hampden.
	George Chandler, M. D.	Worcester	Worcester.
	D. J. Holmes James Orton	Williamstown	Berkshire.
	Hon. Wm. Mitchell	Nantucket	Nantucket.
	R. D. Mussey	Rockport	Essex.
	Dr. J. Geo. Metcalf	Mendon	Worcester.
	Dr. H. C. Perkins	Newburyport	Essex.
	Henry Rice	North Attleboro'	Bristol.
	Samuel Rodman	New Bedford	Bristol.
	Dr. James Robbins	Uxbridge	Worcester.
	Prof. E. S. Snell	Amherst	Hampshire.
	Dr. E. A. Smith	Worcester	Worcester.
	Albert Schlegel	Taunton	Bristol.
Rhode Island	Prof. A. Caswell	Providence	Providence.
	George Manchester	Portsmouth	Newport.
	Samuel Powel	Newport	Newport.
	Henry C. Sheldon	North Scituate	Providence.
Connecticut	Rev. T. Edwards	New London	New London.
	T. S. Gold	West Cornwall	Litchfield.
	D. Hunt	Pomfret	Windham.
	Prof. J. Johnston	Middletown	Middlesex.
	Dr. Ovid Plumb	Salisbury	Litchfield.
	James Rankin	Saybrook	Middlesex.
New York	E. M. Alba	Angelica	Alleghany.
	Edward A. H. Allen	Troy	Rensselaer.
	Thomas B. Arden	Beverly	Putnam.
	Warren P. Adams	Glen's Falls	Warren.
	Charles A. Avery	Seneca Falls	Seneca.
	John Bowman	Baldwinsville	Onondaga.
	S. De Witt Bloodgood	New York	New York.

METEOROLOGICAL LIST—Continued.

State.	Name of observer.	Residence.	County.
New York—Con	Eph. N. Byram	Sag Harbor	Suffolk.
	J. Everett Breed	Smithville	Jefferson.
	C. Thurston Chase	Chatham	Columbia.
	E. A. Dayton	Madrid	St. Lawrence.
	J. S. Gibbons	New York	New York.
	W. E. Guest	Ogdensburg	St. Lawrence.
	J. Caroll House	Lowville	Lewis.
	J. H. Hart	Oswego	Oswego.
	Dr. S. B. Hunt	Buffalo	Erie.
	E. W. Johnson	Canton	St. Lawrence.
	John Lefferts	Lodi	Seneca.
	L. A. Langdon	Falconer	Chautauque.
	Charles A. Lee	Peekskill	Westchester.
	Capt. W. S. Malcom	Oswego	Oswego.
	L. F. Munger	Le Roy	Genessee.
	Prof. D. J. Pratt	Fredonia	Chautauque.
	Dr. J. W. Smith	East Franklin	Delaware.
	Elias O. Salisbury	Buffalo	Erie.
	Dr. H. P. Sartwell	Penn Yan	Yates.
	Rev. Thomas H. Strong	Flatbush	Kings.
	Stillman Spooner	Wampsville	Madison.
	C. S. Woodward	Beaver Brook	Sullivan.
	P. O. Williams	Gouverneur	St. Lawrence.
	Walter D. Yale	Houseville	Lewis.
New Jersey	Robert L. Cooke	Bloomfield	Essex.
	Prof. Geo. H. Cook	New Brunswick	Middlesex.
	Rev. Ad. Frost	Burlington	Burlington.
	E. T. Mack	New Brunswick	Middlesex.
	W. A. Whitehead	Newark	Essex.
Pennsylvania	Samuel Brown	Bedford	Bedford.
	W. O. Blodget	Sugar Grove	Warren.
	Dr. A. C. Blodget	Youngsville	Warren.
	John Comly	Byberry	Philadelphia.
	D. S. Deering	Brookville	Jefferson.
	Fenelon Darlington	Pocopson	Chester.
	Joseph Edwards	Chromedale	Delaware.
	Rev. D. J. Eyler	Waynesboro'	Franklin.
	John Heisely	Harrisburg	Dauphin.
	Ebenezer Hance	Morrisville	Bucks.
	O. T. Hobbs	Randolph	Crawford.
	John Hughes	Pottsville	Schuylkill.
	M. Jacobs	Gettysburg	Adams.
	Prof. J. A. Kirkpatrick	Philadelphia	Philadelphia.
	J. R. Lowrie	Warrior's Mark	Huntington.
	Rev. J. Grier Ralston	Norristown	Montgomery.
	Paul Swift	Haverford	Philadelphia.
	Francis Schreiner	Moss Grove	Crawford.
	Dr. H. Smyser	Pittsburgh	Alleghany.
	Dr. R. P. Stephens	Ceres	McKean.
	T. H. Thickstun	Meadville	Crawford.
	A. D. Weir	Freeport	Armstrong.
	W. W. Wilson	Pittsburgh	Alleghany.
	R. Weiser	Andersville	Perry.
Delaware	Prof. W. A. Crawford	Newark	New Castle.
	J. P. Walker	Dover	Kent.
Maryland	Prof. William Baer } Miss H. M. Baer }	Sykesville	Carroll.
	Rev. John P. Carter	Hagerstown	Washington.
	Henry E. Hanshaw	Frederick	Frederick.
	Benj. O. Lowndes	Blenheim	Prince George's.
	Prof. Jas. F. Maguire	New Windsor	Carroll.
Virginia	Lieut. R. F. Astrop	Crichton's Store	Brunswick.
	Samuel Couch	Ashland	Putnam.
	Benj. Hallowell	Alexandria	Alexandria.

METEOROLOGICAL LIST—Continued.

State.	Name of observer.	Residence.	County.
Virginia—Continued	Jed. Hotchkiss	Bridgewater	Rockingham.
	Samuel X. Jackson	Leesburg	Loudon.
	William S. Kern	Huntersville	Pocahontas.
	Charles J. Meriwether	Montcalm	Albemarle.
	J. W. Marvin	Winchester	Frederick.
	A. Nettleton	Lynchburg	Campbell.
	Thomas Patton	Lewisburg	Greenbier.
	Prof. Geo. R. Rosseter	Buffalo	Putnam.
	David Turner	Richmond	Henrico.
	Prof. N. B. Webster	Portsmouth	Norfolk.
North Carolina	Rev. Fred. Fitzgerald	Jackson	Northampton.
	Dan. Morelle	Thornbury	Northampton.
	Prof. Jas. Phillips	Chapel Hill	Orange.
	Dr. J. Bryant Smith	Lincolnton	Lincoln.
South Carolina	Thornton Carpenter	Camden	Kershaw.
	Alex. Glennie	Waccaman	All Saints Parish.
	H. W. Ravenel	Aiken	Barnwell.
	J. A. Young	Camden	Kershaw.
Georgia	R. T. Gibson	Whitemarsh Island	Chatham.
	William Haines	Augusta	Richmond.
	John F. Posey	Savannah	Chatham.
	Dr. E. M. Pendleton	Sparta	Hancock.
	William Schley	Augusta	Richmond.
	Prof. Wm. D. Williams	Madison	Morgan.
Florida	Dr. A. S. Baldwin	Jacksonville	Duval.
	W. C. Dennis	Key West	Monroe.
	John Newton	Orange Hill	Washington.
	John Pearson	Pensacola	Escambia.
	Aug. Steele	Cedar Keys	Levy.
Alabama	George Benagh	Tuscaloosa	Tuscaloosa.
	S. J. Cumming	Monroeville	Monroe.
	Prof. John Darby	Auburn	Macon.
	Ben. F. Holley	Wetokaville	Talladega.
	R. T. Meriwether	McMath's P. O.	Tuscaloosa.
	H. Tutwiler	Green Springs	Green.
	Prof. M. Tuomey	Tuscaloosa	Tuscaloosa.
Mississippi	A. R. Green	Jackson	Jackson.
	Prof. L. Harper	Oxford	Lafayette.
	Rev. E. S. Robinson	Garlandsville	Jasper.
	Wm. Henry Waddell	Grenada	Yalabusha.
Louisiana	Dr. E. H. Barton	New Orleans	Orleans.
	Prof. W. P. Riddel	Jackson	St. James Parish.
Texas	Prof. L. C. Ervendberg	New Wied	Comal.
	J. W. Glenn	Austin	Travis.
	Dr. S. K. Jennings	Austin	Travis.
Tennessee	Dr. Robert T. Carver	Friendship	Dyer.
	George Cooke, Prof. L. Griswold	Knoxville	Knox.
	Jas. Higgins	Memphis	Shelby.
	Prof. Hamilton	Trenton	Gibson.
	Prof. Ben. C. Jillson	Lebanon	Wilson.
	W. M. Stewart	Glenwood	Montgomery.
	Prof. A. P. Stewart	Lebanon	Wilson.
Kentucky	O. Beatty	Danville	Boyle.
	E. L. Berthoud	Maysville	Mason.
	Rev. J. Miller, Rev. G. S. Savage	Millersburg	Bourbon.
	L. G. Ray	Paris	Bourbon.
	Dr. John Swain	Ballardsville	Oldham.
	J. D. Shane	Lexington	Fayette.
	Mrs. Lawrence Young	Springdale	Jefferson.
Ohio	Prof. J. W. Andrews	Marietta	Washington.
	Prof. G. M. Barber	Berea	Cuyahoga.
	R. S. Bosworth	College Hill	Hamilton.
	F. A. Benton	Mount Vernon	Knox.

METEOROLOGICAL LIST—Continued.

State.	Name of observer.	Residence.	County.
Ohio—Continued	Geo. L. Crookham	Jackson, C. H.	Jackson.
	Miss Ardelia Cunningham	Unionville	Lake.
	Jacob N. Desellem	Richmond	Jefferson.
	Lewis M. Dayton	Newark	Licking.
	J. H. Fairchild	Oberlin	Loraine.
	L. Groneweg	Germantown	Montgomery.
	G. A. Hyde	Norwalk	Huron.
	F. Hollenbeck	Perrysburg	Wood.
	Dr. J. G. F. Holston	Zanesville	Muskingum.
	F. W. Hurtt	Cincinnati	Hamilton.
	Dr. John Ingram	Savannah	Ashland.
	Dr. J. P. Kirtland	East Rockport	Cuyahoga.
	G. W. Livezay	Gallipolis	Gallia.
	John F. Lukens	Zanesfield	Logan.
	J. McD. Mathews	Hillsboro'	Highland.
	G. S. Ormsby	College Hill	Hamilton.
	Prof. S. N. Sanford	Granville	Licking.
	Robert Shields	Bellcentre	Logan.
	E. Spooner	Keen	Coshocton.
	Edmund West	Huron	Erie.
Michigan	William Campbell	Battle Creek	Calhoun.
	Alfred E. Currier	Grand Rapids	Kent.
	Rev. Geo. Duffield	Detroit	Wayne.
	Dr. S F. Mitchell	East Saginaw	Saginaw.
	Capt. A. D. Perkins	Monroe	Monroe.
	H. R. Schetterly	Grand Traverse	Michilimackinac.
	L. H. Streng	Saugatuck	Alleghany.
	J. J. Strang	St. James	Michilimackinac.
	Dr. M. V. Taylor	Brooklyn	Jackson.
	Miss Octavia C. Walker	Cooper	Kalmazoo.
	Dr. Thomas Whelpley	Brest	Monroe.
	Lorin Woodruff	Ann Arbor	Washtenaw.
	A. Winchell	Ann Arbor	Washtenaw.
Indiana	W. W. Austin	Richmond	Wayne.
	C. Barnes	Madison	Jefferson.
	A. H. Bixby	Lafayette	Tippecanoe.
	J. Chappelsmith	New Harmony	Posey.
	W. B. Coventry	Kendallville	Noble.
	Dr. V. Kersey	Milton	Wayne.
	J. Knauer	Kendallville	Noble.
	H. Peters	Lafayette	Tippecanoe.
	D. H. Roberts	New Garden	Wayne.
	Prof. Joseph Tingley	Greencastle	Putnam.
Illinois	Prof. W. Coffin	Batavia	Kane.
	L. G. Edgerly	Granville	Putnam.
	John Grant	Manchester	Scott.
	Joel Hall	Athens	Menard.
	Dr. J. A. Harris	Ottawa	La Salle.
	Dr. John James	Upper Alton	Madison.
	Dr. S. B. Mead	Augusta	Hancock.
Missouri	Fred. Behmer	Fort Pierre	
	Dr. Engelmann	St. Louis	St. Louis.
	O. H. P. Lear	Dry Ridge	Marion.
Iowa	Miss Ida E. Ball	Keokuk	Lee.
	E. C. Bidwell	Quasqueton	Buchanan.
	Dr. Asa Horr	Dubuque	Dubuque.
	Daniel McCready	Fort Madison	Lee.
	Benjamin F. Odell	Poultney	Delaware.
	Rev. Joshua Phelps	Alexander College	Dubuque.
	P. G. Parvin	Muscatine	Muscatine.
	E. H. A. Scheeper	Pella	Marion.
Wisconsin	Miss M. E. Baker	Ceresca	Fond du Lac.
	Thomas Gay	Belle Fontaine	Marquette.
	L. A. Lapham	Milwaukie	Milwaukie.
	Prof. S. P. Lathrop	Beloit	Rock.

METEOROLOGICAL LIST—Continued.

State.	Name of observer.	Residence.	County.
Wisconsin—Contin'd.	G. F. Livingston	Hudson	St. Croix.
	Dr. J. L. Pickard	Platteville	Grant.
	J. McQuigg	Beloit	Rock.
	W. Porter		
	S. H. Carpenter	Madison	Dane.
	J. W. Sterling		
	Edward S. Spencer	Summit	Waukesha.
	J. F. Willard	Janesville	Rock.
	Carl Winkler	Milwaukie	Milwaukie.
Minnesota	C. F. Anderson	St. Anthony's Falls	Ramsey.
	Rev. Elisha W. Carver	Red Lake	Pembina.
	A. O. Kellum	St. Joseph	Pembina.
	Rev. S. W. Mauncey	Fort Ripley	
	S. R. & A. L. Riggs	Lac qui parle	Dahkota.
	David B. Spencer	St. Joseph	Pembina.
California	Dr. H. Gibbons	San Francisco	San Francisco.
	Dr. F. W. Hatch	Sacramento	Sacramento.
	Rev. J. A. Shepherd	San Francisco	San Francisco.
Nebraska	D. E. Reed	Bellevieu	
Paraguay	E. A. Hopkins	Ascension	

Meteorological observers—New York University system.

Name.	Residence.	County.
M. R. Batchelder	Fredonia	Chautauque.
John N. Brinkerhoff	Union Hall, Jamaica	Queen's.
Prof. Chester Dewey	Rochester	Monroe.
John Felt, jr	Liberty	Sullivan.
W. H. Gillespie	Mexico	Oswego.
Ira F. Hart	Elmira	Chemung.
John F. Jenkins	White Plains	Westchester.
Mrs. M. T. Lobdell	North Salem	Westchester.
A. W. Morehouse	Spencertown	Columbia.
Prof. O. W. Morris	Institute for Deaf and Dumb	New York city.
Prof. David Murray	Albany	Albany.
Edw. C. Reed	Horner	Cortland.
Prof. O. Root	Clinton	Oneida.
J. O. Stratton	Oxford	Chenango.
Jos. W. Taylor	Plattsburg	Clinton.
Rev. R. D. Van Kleek	Flatbush	King's.
Prof. W. D. Wilson	Geneva	Ontario.

ALPHABETICAL LIST OF METEOROLOGICAL OBSERVERS.

Name.	Residence.	State.
Adams, Warren P	Glen's Falls	New York.
Alba, E. M	Angelica	New York.
Allen, Edw. A. H	Troy	New York.
Allin, Lucius C	Springfield	Massachusetts.
Anderson, C. F	St. Anthony's Falls	Minnesota.
Andrews, Prof. J. W	Marietta	Ohio.
Arden, Thos. B	Beverly	New York.
Astrop, Lieut. R. F	Crichton's store	Virginia.
Austin, W. W	Richmond	Indiana.
Avery, Chas. A	Seneca Falls	New York.
Bacon, Wm	Richmond	Massachusetts.
Baer, Miss H. M	Sykesville	Maryland.
Baer, Prof. Wm	Sykesville	Maryland.
Baker, Miss M. E	Ceresca	Wisconsin.
Baldwin, Dr. A. S	Jacksonville	Florida.
Ball, Miss Ida E	Keokuk	Iowa.
Barber, Prof. G. M	Berea	Ohio.
Barnes, C	Madison	Indiana.
Barrows, Geo. B	Fryeburg	Maine.
Bartlett, Joshua	South Thomaston	Maine.
Barton, Dr. E. H	New Orleans	Louisiana.
Batchelder, M. R	Fredonia	New York.
Beatty, O	Danville	Kentucky.
Behmer, F	Fort Pierre	Missouri.
Bell, John J	Carmel	Maine.
Bell, Samuel N	Manchester	New Hampshire.
Benagh, George	Tuscaloosa	Alabama.
Benton, F. A	Mount Vernon	Ohio.
Berthoud, E. L	Maysville	Kentucky.
Bidwell, E. C	Quasqueton	Iowa.
Bixby, A. H	Lafayette	Indiana.
Blodget, Dr. A. C	Youngsville	Pennsylvania.
Blodget, W. O	Sugar Grove	Pennsylvania.
Bloodgood, S. De Witt	New York	New York.
Bosworth, R. S	College Hill	Ohio.
Bowman, John	Baldwinsville	New York.
Breed, J. Everett	Smithville	New York.
Brinkerhoff, John N	Union Hall, Jamaica	New York.
Brooks, John	Princeton	Massachusetts.
Brown, Samuel	Bedford	Pennsylvania.
Buckland, D	Brandon	Vermont.
Byram, E. N	Sag Harbor	New York.
Campbell, Wm	Battle Creek	Michigan.
Carpenter, S. H	Madison	Wisconsin.
Carpenter, Thornton	Camden	South Carolina.
Carter, Rev. Jno. P	Hagerstown	Maryland.
Carver, Rev. E. W	Red Lake	Minnesota.
Carver, Dr. Robt. T	Friendship	Tennesse.
Caswell, Prof. A	Providence	Rhode Island.
Chadbourne, Prof. P. A	Williamstown	Massachusetts.
Chandler, Dr. George	Worcester	Massachusetts.
Chappelsmith, John	New Harmony	Indiana.
Chase, C. Thurston	Chatham	New York.
Coffin, Prof. W	Batavia	Illinois.
Colby, Jas. K	St. Johnsbury	Vermont.
Comly, John	Byberry	Pennsylvania.
Conant, Marshal	Bridgewater	Massachusetts.
Cooke, George	Knoxville	Tennessee.
Cooke, Robert L	Bloomfield	New Jersey.
Cook, Prof. George H	New Brunswick	New Jersey.
Couch, Samuel	Ashland	Virginia.
Coventry, W. B	Utica	New York.
Crawford, Prof. W. A	Newark	Delaware.

METEOROLOGICAL LIST—Continued.

Name.	Residence.	State.
Crookham, George L	Jackson	Ohio.
Cumming, S. J	Monroeville	Alabama.
Cunningham, Miss A	Unionville	Ohio.
Currier, Alfred E	Grand Rapids	Michigan.
Dana, William D	Perry	Maine.
Darby, Prof. John	Auburn	Alabama.
Darlington, Fenelon	Pocopson	Pennsylvania.
Davis, Emerson	Westfield	Massachusetts.
Dayton, E. A	Madrid	New York.
Dayton, Lewis M	Newark	Ohio.
Deering, D. S	Brookville	Pennsylvania.
Dennis, W. C	Key West	Florida.
Desellem, Jacob N	Richmond	Ohio.
Dewey, Professor Chester	Rochester	New York.
Duffield, Rev. George	Detroit	Michigan.
Edgerly, L. G	Granville	Illinois.
Edwards, Joseph	Chromedale	Pennsylvania.
Edwards, Rev. T	New London	Connecticut.
Engelmann, Dr	St. Louis	Missouri.
Ervendburg, Prof. L. C	New Wied	Texas.
Eveleth, Samuel A	Windham	Maine.
Eyler, Rev. D. J	Waynesboro'	Pennsylvania.
Fairbanks, J. P	St. Johnsbury	Vermont.
Fairchild, J. H	Oberlin	Ohio.
Felt, John	Liberty	New York.
Fitzgerald, Rev. F	Jackson	North Carolina.
Frost, Rev. A	Burlington	New Jersey.
Gay, Thomas	Bellefontaine	Wisconsin.
Gibbons, Dr. H	San Francisco	California.
Gibbons, J. S	New York	New York.
Gibson, R. T	Whitemarsh Island	Georgia.
Gifford, R. R	Wood's Hole	Massachusetts.
Gillespie, W. H	Mexico	New York.
Glennie, Alexander	Waccaman	South Carolina.
Glenn, J. W	Austin	Texas.
Gold, T. S	West Cornwall	Connecticut.
Grant, John	Manchester	Illinois.
Green, A. R	Jackson	Mississippi.
Griswold, Prof. L	Knoxville	Tennessee.
Groneweg, L	Germantown	Ohio.
Guest, W. E	Ogdensburg	New York.
Haines, William	Augusta	Georgia.
Hall, Joel	Athens	Illinois.
Hallowell, Benjamin	Alexandria	Virginia.
Hamilton, Professor	Trenton	Tennessee.
Hance, Ebenezer	Morrisville	Pennsylvania.
Hanshaw, Henry E	Frederick	Maryland.
Harper, Prof. L	Oxford	Mississippi
Harris, Dr. J. O	Ottawa	Illinois.
Hart, Ira F	Elmira	New York
Hart, J. H	Oswego	New York.
Hatch, Dr F. W	Sacramento	California.
Heisley, John	Harrisburg	Pennsylvania.
Higgins, James	Memphis	Tennessee.
Hobbs, O. T	Randolph	Pennsylvania.
Holcomb, Amasa	Southwick	Massachusetts
Hollenbeck, F	Perrysburg	Ohio.
Holley, B. F	Wetokaville	Alabama.
Holmes, D. J	Williamstown	Massachusetts
Holston, Dr. J. G. F	Zanesville	Ohio.
Hopkins, E. A	Ascension	Paraguay.

METEOROLOGICAL LIST—Continued.

Name.	Residence.	State.
Horr, Dr. Asa	Dubuque	Iowa.
Hotchkiss, Jed	Bridgewater	Virginia.
House, J. Carroll	Lowville	New York.
Hughes, John	Pottsville	Pennsylvania.
Hunt, D	Pomfret	Connecticut.
Hunt, Dr. S. B	Buffalo	New York.
Hurtt, F. W	Cincinnati	Ohio.
Hyde, G. A	Norwalk	Ohio.
Ingram, Dr. John	Savannah	Ohio.
Jackson, Samuel X	Leesburg	Virginia.
Jacobs, M	Gettysburg	Pennsylvania.
James, Dr. John	Upper Alton	Illinois.
Jenkins, J. F	White Plains	New York.
Jennings, Dr. S. K	Austin	Texas.
Jillson, Professor B. C	Lebanon	Tennessee.
Johnson, E. W	Canton	New York.
Johnston, Professor J	Middletown	Connecticut.
Kellum, O. A	St. Joseph's	Minnesota.
Kersey, Dr. V	Milton	Indiana.
Kirkpatrick, Prof. J. A	Philadelphia	Pennsylvania.
Kirkland, Dr. J. P	East Rockport	Ohio.
Knauer, J	Kendallville	Indiana.
Langdon, L. A	Falconer	New York.
Lapham, I. A	Milwaukie	Wisconsin.
Lathrop, Prof. S. P	Beloit	Wisconsin.
Lear, O. H. P	Dry Ridge	Missouri.
Lee, Charles A	Peekskill	New York.
Lefferts, John	Lodi	New York.
Leonard, Rev. L. W	Exeter	New Hampshire.
Livezay, G. W	Gallipolis	Ohio.
Livingston, G. Z	Hudson	Wisconsin.
Lobdell, Mrs. Mary J	Salem Centre	New York.
Lowndes, B. O	Blenheim	Maryland.
Lowrie, J. R	Warrior's Mark	Pennsylvania.
Lukens, John F	Zanesville	Ohio.
Mack, E. T	New Brunswick	New Jersey.
Mack, R. C	Londonderry	New Hampshire
Maguire, Prof. J. F	New Windsor	Maryland.
Malcom, Captain W. S	Oswego	New York.
Manchester, George	Portsmouth	Rhode Island.
Marsh, Charles A. J	Craftsbury	Vermont.
Marvin, J. W	Winchester	Virginia.
Mauncey, Rev. S. W	Fort Ripley	Minnesota.
Matthews, J. McD	Hillsboro'	Ohio.
McCready, D	Fort Madison	Iowa.
McQuigg, J	Beloit	Wisconsin.
Mead, Dr. S. B	Augusta	Illinois.
Meriwether, Charles J	Montcalm	Virginia.
Meriwether, R. T	McMath's	Alabama.
Merrill, Rev. S. H	Bluehill	Maine.
Metcalf, Dr. J. G	Mendon	Massachusetts.
Miller, Rev. J	Millersburg	Kentucky.
Mitchell, Dr. S. K	East Saginaw	Michigan.
Mitchell, Hon. Wm	Nantucket	Massachusetts.
Morehouse, A. W	Spencertown	New York.
Morelle, D	Thornbury	North Carolina.
Morris, Prof. O. W	New York	New York.
Munger, L. F	Le Roy	New York.
Murray, Prof. David	Albany	New York.
Mussey, R. D	Rockport	Massachusetts.

METEOROLOGICAL LIST—Continued.

Name.	Residence.	State.
Nettleton, A	Lynchburg	Virginia.
Newton, Jno	Orange Hill	Florida.
Newton, W. H	Fond du Lac	Minnesota.
Odell, B. F	Poultney	Iowa.
Ormsby, J. S	College Hill	Ohio.
Orton, Jas.	Williamstown	Massachusetts.
Paddock, Jas. A	Craftsbury	Vermont.
Parker, J. D	Steuben	Maine.
Parvin, T. S	Muscatine	Iowa.
Patton, Thos	Lewisburg	Virginia.
Pearson, Jno	Pensacola	Florida.
Pendleton, Dr. E. M	Sparta	Georgia.
Perkins, Capt. A. D	Monroe	Michigan.
Perkins, Dr. H. C	Newburyport	Massachusetts.
Peters, H	Lafayette	Indiana.
Phelps, Rev. Joshua	Alexander College	Iowa.
Phillips, Prof. Jas	Chapel Hill	North Carolina.
Pickard, Dr. J. L	Plattsville	Wisconsin.
Plumbe, Dr. Ovid	Salisbury	Connecticut.
Poole, Henry	Albion Mines	Nova Scotia.
Porter, W	Beloit	Wisconsin.
Posey, John F	Savannah	Georgia.
Powel, Sam'l	Newport	Rhode Island.
Pratt, Prof. D. J	Fredonia	New York.
Prescott, Dr. Wm	Concord	New Hampshire.
Ralston, Rev. J. G	Norristown	Pennsylvania.
Rankin, James	Saybrook	Connecticut.
Ravenel, H. W	Aiken	South Carolina.
Ray, L. G	Paris	Kentucky.
Reed, D. E	Belleview	Nebraska Territory.
Reed, Edward C	Homer	New York.
Rice, Henry	North Attleboro'	Massachusetts.
Riddle, Professor W. P	Jackson	Louisiana.
Riggs, S. R. and A. L	Lac qui Parle	Minnesota.
Robbins, Dr. James	Uxbridge	Massachusetts.
Robinson, Rev. E. S	Garlandsville	Mississippi.
Rodman, Samuel	New Bedford	Massachusetts.
Root, Professor O	Clinton	New York.
Rosseter, Professor Geo. R	Buffalo	Virginia.
Salisbury, Elias O	Buffalo	New York.
Sanford, Professor S. N	Granville	Ohio.
Sartwell, Dr. H. P	Penn Yan	New York.
Savage, Rev. G. S	Millersburg	New York.
Sawyer, George B	Salmon Falls	New Hampshire.
Sawyer, Henry E	Great Falls	New Hampshire.
Scheeper, E. H. A	Pella	Iowa.
Schetterly, H. R	Grand Traverse	Michigan.
Schlegel, Albert	Taunton	Massachusetts.
Schley, William	Augusta	Georgia.
Schreiner, Francis	Moss Grove	Pennsylvania.
Shane, J. D	Lexington	Kentucky.
Sheldon, Henry C	North Scituate	Rhode Island.
Shepherd, Rev. J. A	San Francisco	California.
Shields, Robert	Bellecentre	Ohio.
Skeen, William	Huntersville	Virginia.
Smallwood, Dr. Charles	St. Martin's	Canada.
Smith, Dr. E. A	Worcester	Massachusetts.
Smith, Dr. J. Bryant	Lincolnton	North Carolina.
Smith, Dr. J. W	East Franklin	New York.
Smyser, Dr. H	Pittsburg	Pennsylvania.
Snell, Professor E. S	Amherst	Massachusetts.
Spencer, David B	St. Joseph	Minnesota.

METEOROLOGICAL LIST—Continued.

Name.	Residence.	State.
Spencer, Edward S	Summit	Wisconsin.
Spooner, E	Keen	Ohio.
Spooner, Stillman	Wampsville	New York.
Steele, Augustus	Cedar Keys	Florida.
Sterling, J. W	Madison	Wisconsin.
Stevens, Dr. R. P	Ceres	Pennsylvania.
Stewart, Prof. A. P	Lebanon	Tennessee.
Stewart, W. M	Greenwood	Tennessee.
Strang, J. J	St. James	Michigan.
Stratton, J. O	Oxford	New York.
Strong, L. H	Saugatuck	Michigan.
Strong, Rev. T. H	Flatbush	New York.
Stuart, A. P. S	Wolfville	Nova Scotia.
Swain, Dr. John	Ballardsville	Kentucky.
Swift, Paul	Haverford	Pennsylvania.
Taylor, Jos. W	Plattsburg	New York.
Taylor, Dr. M. K	Brooklyn	Michigan.
Thickstun, T	Meadville	Pennsylvania.
Thompson, Zadock	Burlington	Vermont.
Tingley, Prof. Jas	Greencastle	Indiana.
Tuomey, Prof. M	Tuscaloosa	Alabama.
Turner, David	Richmond	Virginia.
Tutwiler, H	Green Springs	Alabama.
Underwood, D	Castleton	Vermont.
Van Kleek, Rev. R. D	Flatbush	New York.
Waddell, Wm. H	Grenada	Mississippi.
Walker, Miss Octavia C	Cooper	Michigan.
Walker, J. P	Dover	Delaware.
Webster, Prof. N. B	Portsmouth	New Hampshire.
Weir, A. D	Freeport	Pennsylvania.
Weiser, R	Andersville	Pennsylvania.
West, Edmund	Huron	Ohio.
Whelpley, Dr. Thos	Brest	Michigan.
Whitehead, W. A	Newark	New Jersey.
Willard, J. F	Janesville	Wisconsin.
Williams, P. O	Gouverneur	New York.
Williams, Prof. W. D	Madison	Georgia.
Wilson, Prof. W. D	Geneva	New York.
Wilson, W. W	Pittsburg	Pennsylvania.
Winchell, A	Ann Arbor	Michigan.
Winkler, Carl	Milwaukie	Wisconsin.
Woodruff, Lum	Ann Arbor	Michigan.
Woodward, C. S	Beaver Brook	New York.
Yale, Walter D	Houseville	New York.
Young, Albert A	Hanover	New Hampshire.
Young, J. A	Camden	South Carolina.
Young, Mrs. Lawrence	Springdale	Kentucky.
Young, Prof. Ira	Hanover	New Hampshire.

REPORT OF THE EXECUTIVE COMMITTEE.

ADOPTED JANUARY 15, 1855.

The Executive Committee submit to the Board of Regents the following report relative to the present state of the finances, and the expenditures during the year 1854.

The whole amount of the Smithsonian bequest, deposited in the treasury of the United States (from which an annual income, at 6 per cent., is derived of $30,910 14) is		$515,169 00
Amount of unexpended interest, reported last year as in charge of Messrs. Corcoran and Riggs	$179,408 02	
From which deduct amount passed by them to the credit of the treasurer, to meet payments on building during 1854	54,408 02	
	125,000 00	
Balance in the treasury, January 1, 1855	14,159 59	
		139,159 59
		$654,328 59

The following is a general view of the receipts and expenditures for the year 1854, exclusive of amount drawn from Corcoran and Riggs on account of the building.

RECEIPTS.

Balance in the treasury, as per last report	$6,944 68	
Interest on the original fund for the year 1854	30,910 21	
Interest on the extra fund for the year 1854	7,276 39	
		$45,131 28

EXPENDITURES.

For items common to the objects of the Institution	$12,752 00	
For publications, researches, and lectures	8,094 38	
For library, museum, and gallery of art	9,512 19	
For building purposes—difference between the amount expended and the amount withdrawn from Corcoran and Riggs	613 12	
Balance in the treasury	14,159 59	
		$45,131 28

Detailed statement of the expenditures during 1854.

BUILDING, FURNITURE, FIXTURES, ETC.		
Pay on contracts	$52,280 00	
Pay of architect and draftsman	1,237 00	
Miscellaneous incidental to building	495 13	
Magnetic observatory	18 77	
Furniture, &c., for uses in common	938 12	
Furniture, &c., for library	52 12	
		$55,021 14
GENERAL EXPENSES.		
Expenses of Board of Regents, &c	467 71	
Lighting and heating	887 30	
Postage	467 67	
Transportation and exchanges	1,644 43	
Stationery	662 50	
General printing	1,094 22	
Apparatus	427 26	
Incidentals general, including salary of clerk, book-keeper, janitor, watchman, laborer, extra clerk hire	3,600 99	
Salary of Secretary	3,499 92	
		12,752 00
PUBLICATIONS, RESEARCHES, AND LECTURES.		
Smithsonian Contributions to Knowledge	3,773 96	
Reports on progress of knowledge	83 84	
Other publications	917 89	
Meteorology	2,203 38	
Investigations	10 00	
Pay of lectures	895 00	
Illustrations and apparatus for lectures	156 37	
Attendance and lighting lectures, &c	53 94	
		8,094 38
LIBRARY, MUSEUM, AND GALLERY OF ART.		
Cost of books	2,166 50	
General catalogue	151 35	
Stereotyping and printing	551 71	
Incidentals, library, including salary of two assistants, and binding	2,329 55	
Salary of Assistant Secretary	1,319 43	
Explorations, museum	250 00	
Expenses of collections, museum	157 19	
Incidentals, including alcohol, &c., assistance and labor, apparatus, catalogue, glass jars, &c	536 54	
Salary of Assistant Secretary	1,999 92	
Incidentals, gallery of art	50 00	
		9,512 19
Total expenditures in 1854		85,379 71

In the appropriations made, April, 1854, for the year the estimated income of the Institution was $38,500—[the actual income was $38,186 60]—of this sum $7,000 was devoted to the building and the remaining $31,500 to the operations of the Institution.

The first mentioned sum (7,000) is included in the balance in the treasury, the whole of which may be appropriated during the present year to the building.

The whole expenditure on the operations of the Institution was $30,358 57, which is $1,141 83 less than was appropriated.

The appropriation was not made until one-third of the year had passed, and this, with the unusual expenditure occasioned by a call of a special meeting of the Board, and the extra clerk hire and printing on account of the various reports, rendered it impossible to apportion the disbursements in exact conformity to the estimates. They will be found, however, approximately to agree—those for publications, &c., being less, and those for library, museum, &c., more.

On account of the additions which the building committee have found it necessary to make to the contract for the better security and adaptation of the building, the extra fund has been reduced to $140,000, instead of $150,000, as was formerly contemplated. It is probable a further reduction will be required to pay the amount still due on the contract, and for other purposes connected with the building, but this should not be allowed to diminish the extra fund below $125,000.

The following table presents a general exhibit of all the receipts and expenditures on account of the Smithsonian fund, from the beginning of the Institution until the first of January, 1855.

General statement of the expenditures of the Smithsonian Institution.

	To Dec. 31, 1847.	Year 1848.	Year 1849.	Year 1850.	Year 1851.	Year 1852.	Year 1853.	Year 1854.	Aggregate.
1. *Building, furniture, and fixtures, grounds.*	Dolls. Cts.	Dolls. Cts.	Dolls. Cts.	Dolls. Cts.	Dolls. Cts.	Dolls. Cts.	Dolls. Cts.	Dolls. Cts.	Dolls. Cts.
Pay on contracts for building	22,899 00	48,810 00	50,300 00	24,000 00	22,000 00	10,000 00	25,500 00	52,280 00	255,780 00
Pay of architects, superintendents, &c.	3,482 76	2,949 86	3,124 12	2,459 42	2,214 45	1,839 83	1,580 70	1,237 00	18,888 14
Expenses of building committee	1,338 85	17 24	....	6 00	43 53	7 50	77 00	....	1,490 12
Experiments, &c. on building materials	488 13	62 00	15 50	....	....	....	....	....	565 63
Examination of quarries	250 76	....	....	....	....	....	....	....	250 76
Premiums paid architects	1,250 00	....	....	....	....	....	....	....	1,250 00
Miscellaneous, incidental to building	509 63	1,738 65	1,980 18	1,868 05	62 07	1,198 64	184 84	495 13	8,037 19
Magnetic observatory	....	....	....	....	....	....	1,578 28	18 77	1,597 05
Furniture and fixtures for uses in common	....	....	1,717 52	892 93	657 06	682 94	354 05	938 12	5,242 62
Do.........do....for publications	....	....	....	....	21 00	....	....	....	21 00
Do.........do....for lectures	....	....	25 00	166 50	149 99	....	....	....	341 49
Do.........do....for library	....	....	347 00	545 80	255 22	265 15	117 11	52 12	1,582 40
Do.........do....for museum	....	....	....	....	52 68	3 56	....	....	56 24
Do.........do....for gallery of art	....	....	....	....	....	....	....	....	....
Grounds	1,293 50	109 88	727 17	1,615 96	515 54	49 45	....	....	4,311 50
	31,503 63	53,687 63	58,236 49	31,554 66	25,971 54	14,047 07	29,391 98	55,021 14	299,414 14
2. *General expenses.*									
Expenses of regents and committees	3,323 45	114 25	84 25	216 12	291 20	267 18	195 00	467 71	4,959 16
Lighting and heating	....	....	378 95	58 50	486 35	399 70	646 47	887 30	2,857 27
Postage	60 06	65 76	307 36	183 05	370 78	472 07	364 28	467 67	2,291 03
Transportation	36 96	85 92	266 19	517 55	851 43	1,827 91	1,913 19	1,644 43	7,143 58
Stationery	7 02	63 11	85 46	231 85	419 96	222 38	6 50	662 50	1,698 78
General Printing	294 63	68 50	199 00	134 25	1,159 06	350 42	894 19	1,094 22	4,194 27
Apparatus	1,546 47	412 71	1,799 90	899 92	148 69	844 88	203 50	427 26	6,283 33
Incidentals general	1,947 75	1,337 03	1,847 33	1,441 72	1,878 43	2,821 34	3,352 42	....	14,626 02
Salaries	1,014 49	4,265 20	4,811 58	4,548 48	3,799 92	4,299 92	4,099 92	6,733 91	33,573 42
Watchmen	....	....	....	....	....	....	367 00	367 00	734 00
	8,230 83	6,412 48	9,780 02	8,231 44	9,405 82	11,505 80	12,042 47	12,752 00	78,360 86

3. Publications, researches, and lectures.									
Smithsonian Contributions	756 00	2,956 87	2,082 87	3,662 36	3,211 76	5,736 74	8,160 04	3,773 96	30,340 60
Reports on progress of knowledge			444 00	935 91	473 82	1,616 75	139 29	83 84	3,693 61
Other publications			152 54	585 98	100 00	1,007 86	1 116 58	917 89	3,880 85
Meteorology			814 00	1,256 66	394 50	2,079 88	2,346 51	2,203 38	9,094 93
Computations		525 00	225 00		300 00				1,050 00
Investigations		100 00	50 00	90 00	110 00	75 00		10 00	435 00
Pay of lecturers			275 00	1,521 05	635 00	1,385 00	783 00	895 00	5,494 05
Illustrations and apparatus for lectures				92 22	316 49	230 13	661 84	156 37	1,457 05
Attendance and lighting for.....do		80 00	118 62	38 50	36 75	93 12	445 40	53 94	866 33
Salaries, publications, &c			150 00	1,000 00	900 00				2,050 00
	756 00	3,661 87	4,312 03	9,182 68	6,478 32	12,224 48	13,652 66	8,094 38	58,362 42
4. Library, museum, and gallery of art.									
Cost of books	545 99	365 86	2,878 14	4,225 25	2,016 90	1,098 77	841 75	2,166 50	14,139 16
General catalogue			591 58	284 97	174 88	377 25		151 35	1,580 03
Copyright	35 00		41 66	156 00		52 00			284 66
Incidentals to library		600 00	790 72	833 24	1,402 01	1,196 48	1,581 02		6,403 47
Salaries to library		750 00	2,499 98	1,999 92	1,999 92	2,499 96	2,499 96	3,648 98	15,898 72
Explorations, museum				150 00	50 00		250 00	250 00	700 00
Expenses of collections for museum			184 50	543 00	183 03	215 57	240 04	157 19	1,523 33
Cost of transportation for....do				103 00					103 00
Incidentals for.............do				20 00	512 06	563 01	229 71	536 54	1,861 32
Salaries for...............do				750 00	1,500 00	1,999 94	1,999 92	1,999 92	7,249 78
Purchases for gallery of art				173 30	10 00				183 30
Incidentals for..do.....do			11 25	100 00	6 00			50 00	167 25
Stereotyping						1,305 28	1,318 42	551 71	3,174 41
	580 99	1,715 86	6,997 83	9,338 68	7,854 80	9,308 26	8,960 82	9,512 19	54,269 43
	41,071 45	65,477 84	79,326 37	58,307 46	49,710 48	47,085 61	64,047 93	85,379 71	490,406 85

Dr. *Fund account of*

RECEIPTS.

1846.				
July	1	To James Smithson, net proceeds of his bequest....		$515,169 00
		To interest thereon to date, paid by the United States.		242,129 00
Sept.	10	To H. W. Hilliard, Regent, over payment returned.		90
1847.				
Jan.	1	To interest on assumed debt, 1st July to 31st December, 1846, first half year....................		15,455 07
July	5	To interest on assumed debt, to 1st July, 1847, second half year....................................		15,455 07
Oct.	21	To interest on $250,000 treasury notes, to 17th August, six months..............................		7,500 00
Nov.	26	To proceeds of treasury notes sold, viz: Amount of notes....................................	$10,000 00	
		To interest to day of sale........................	121 67	
				10,121 67
				805,830 71
1848.				
Jan.	1	To proceeds of Professor Henry's Lectures at Princeton..		1,000 00
	15	To interest on assumed debt, to 1st January, 1848, third half year		15,455 00
April	1	To interest on $240,000 treasury notes, to 17th February, 1848, six months......................		7,200 00
	4	To George M. Dallas, chancellor, premium paid for $7,000 treasury notes		105 00
		To $7,000 treasury notes, deposit to credit of Wm. W. Seaton, chairman........................		95 00
May	10	To proceeds of treasury notes, viz: Amount of notes.	7,000 00	
		To premium thereon..............................	140 00	
		To interest to day of sale........................	45 50	
				7,185 50
July	7	To interest on assumed debt, to 1st July, 1848, fourth half year		15,455 00
Aug.	17	To interest on $240,000 treasury notes, to 17th August, six months............................		7,200 00
	24	To proceeds of treasury notes, viz: Amount of notes.	5,000 00	
		Premium $200 00		
		Less commission.................... 12 50		
			187 50	
		To interest to day of sale........................	5 00	
				5,192 50
Oct.	16	To proceeds of treasury notes, viz: Amount of notes.	9,000 00	
		Premium $270 00		
		Less commission.................. 11 25		
			258 75	
		To interest to day of sale........................	85 50	
				9,344 25
				68,232 25
1849.				
Jan.	5	To interest on assumed debt, fifth half year........		15,455 14
Feb.	17	To treasury notes, this amount redeemed and funded in United States six per cent. stock..............		226,000 00
	28	To interest on treasury notes, $226,000, to 17th February, six months..........................		6,780 00
April	17	To United States six per cent. stock sold, viz: Amount of stock............................	16,000 00	
		Premium........................ $1,600 00		
		Less commission............... 20 00		
			1,560 00	
				17,560 00
July	2	To interest on $210,000 stock, from 17th February to 30th June, 1849..............................		4,614 24
	5	To interest on assumed debt, sixth half year........		15,455 07

the Smithsonian Institution. **Cr.**

EXPENDITURES.

1846.			
July	1	By the United States—assumed debt	$515,169 00
Sept.	6	By Wm. W. Seaton, chairman Executive Committee—	
		From treasury United States	2,000 00
	10	Repaid by Mr. Hilliard	90
Dec.	21	From treasury United States	2,000 00
1847.			
Feb.	17	By treasury notes, proceeds of warrants on treasury United States.	250,000 00
	25	By Wm. W. Seaton, chairman Executive Committee—	
		From treasury United States	3,584 07
July	8	Second half year, interest on assumed debt	15,455 07
Oct.	21	Six months' interest on $250,000 treasury notes	7,500 00
Nov.	26	Proceeds of $10,000 notes sold	10,121 67
			805,830 71
1848.			
Jan.	1	By Professor Joseph Henry, Secretary, on account of his salary	1,000 00
	15	By Wm. W. Seaton, chairman Executive Committee, third half year's interest	15,455 00
April	1	By treasury notes, investment of so much interest on notes received this day	7,000 00
		By George M. Dallas, chancellor, balance of said interest	200 00
	4	By Wm. W. Seaton, chairman Executive Committee, deposited by Mr. Dallas	95 00
May	10	Proceeds of notes sold	7,185 50
July	5	Fourth half year's interest	15,455 00
Aug.	2	Interest on treasury notes due 17th August	7,200 00
	24	Proceeds of notes sold	5,192 50
Oct.	16	Proceeds of notes sold	9,344 25
		By profit and loss, premium paid for $7,000 treasury notes	105 00
			68,232 25
1849.			
Jan.	9	By Wm. W. Seaton, chairman Executive Committee, fifth half year's interest	15,450 14
Feb.	17	By United States six per cent. stock, loan of 1847	226,005 00
	28	By Wm. W. Seaton, chairman Executive Committee, interest on treasury notes, 17th February	6,780 00
April	17	Proceeds of stock sold	17,560 00
July	2	Interest on stock to 30th June	4,614 24
	7	Sixth half year's interest	15,455 07
Oct.	20	Proceeds of stock sold	11,287 50

Dr. *Fund account of*

RECEIPTS.

1849.				
Oct.	20	To United States six per cent. stock sold, viz: Amount of stock	$10,000 00	
		Premium $1,312 50		
		Less commission 25 00		
			1,287 50	
				$11,287 50
				297,151 95
1850.				
Jan.	2	To interest on $200,000 six per cent. stock, to 1st of January, six months		6,000 00
	4	To interest on assumed debt, seventh half year		15,455 07
July	2	To interest on $200,000 six per cent. stock, to 30th June, six months		6,000 00
	9	To interest on assumed debt, eighth half year		15,455 07
	27	To United States six per cent. stock sold, viz: Amount of stock	10,000 00	
		Premium $1,400 00		
		Less commission 25 00		
			1,375 00	
				11,375 00
Sept.	19	To United States six per cent. stock sold, viz: Amount of stock	10,000 00	
		To premium	1,600 00	
				11,600 00
Dec.	28	To Washington monument, office furniture sold to that society		50 71
	31	To interest on $180,000 six per cent. stock, to 31st December, six months		5,400 00
				71,335 85
1851.				
Jan.	20	To interest on assumed debt, ninth half year		15,455 07
July	7	To interest on $180,000 six per cent. stock to June 30, six months		5,400 00
	16	To interest on assumed debt, tenth half year		15,455 07
				36,310 14
1852.				
Jan.	7	To interest on $180,000 six per cent. stock to December 31, six months		5,400 00
	20	To interest on assumed debt, tenth half year		15,455 07
	26	To proceeds of six per cent. stock sold, viz: Amount of stock	180,000 00	
		Premium thereon	28,800 00	
				208,800 00
July	2	To interest on assumed debt, half year		15,455 07
Dec.	27	To repayment by J. Wyman on account of Smithsonian Contributions		5 00
	31	To interest on $208,800 from January 26 to September 11, at five per cent		6,554 00
	31	To interest on $208,800 from September 11 to December 31, at four per cent		2,575 20
				254,244 34
1853.				
Jan.	11	To interest on assumed debt, half year		15,455 07
Feb.	11	To repayment on account of apparatus		294 63
March	31	To repayment on account of Smithsonian Contributions		74 00
June	30	To interest on $208,800 from January 1 to June 30, at five per cent		5,220 00

the Smithsonian Institution. CR.

EXPENDITURES.

			297,151 95
1850.			
Jan.	2	By Wm. W. Seaton, chairman Executive Committee, interest on stock to 1st January	$6,000 00
	4	Seventh half year's interest	15,455 07
July	2	By Wm. W. Seaton, treasurer, interest on stock to 30th June	6,000 00
	9	Eighth half year's interest	15,455 07
	27	Proceeds of stock sold	11,375 00
Sept.	19	Proceeds of stock sold	11,600 00
Dec.	28	Furniture sold on account of pay of architects, &c	50 71
	31	Interest on stock to 31st December, 1850	5,400 00
			71,335 85
1851.			
Jan.	20	By W. W. Seaton, treasurer, half year's interest	15,455 07
July	7	By W. W. Seaton, treasurer, interest on stock to June 30	5,400 00
	16	By W. W. Seaton, treasurer, half year's interest	15,455 07
			36,310 14
1852.			
Jan.	7	By W. W. Seaton, treasurer, interest on stock to December 31	5,400 00
	20	By W. W. Seaton, treasurer, half year's interest	15,455 07
	26	By Corcoran & Riggs, amount in their hands, on interest	208,800 00
July	2	By W. W. Seaton, treasurer, half year's interest	15,455 07
Dec.	27	By W. W. Seaton, treasurer, repayment by Wyman	5 00
	31	By W. W. Seaton, treasurer, interest paid by Corcoran & Riggs	6,554 00
	31	....do.............do............do................do	2,575 20
			254,244 34
1853.			
Jan.	11	By W. W. Seaton, treasurer	15,455 07
Feb.	11	....do.............do	294 63
March	31	....do.............do	74 00
June	30	....do.............do	5,220 00
July	2	....do.............do	15,455 07
Dec.	7	....do.............do	40 00

DR. *Fund account of*

RECEIPTS.

1853.				
July	2	To interest on assumed debt, half year		$15,455 07
Dec.	7	To repayment on account of Smithsonian Contributions		40 00
	31	To interest on $208,800, at five per cent., from July 1 to December 31		5,220 00
				41,758 77
1854.				
Jan.	12	To interest on assumed debt from July 1 to December 31, 1853		15,455 07
	18	To Corcoran & Riggs, on account of funds in their hands		48,800 00
April	1	To Corcoran & Riggs, on account of funds in their hands		10,000 00
July	14	To interest on assumed debt from January 1 to June 30, 1854		15,455 07
	21	To Corcoran & Riggs, interest to June 30, 1854, on funds in their hands		3,875 00
Aug.	7	To Corcoran & Riggs, on account of funds in their hands		10,000 00
Sept.	25	To Corcoran & Riggs, on account of funds in their hands		5,000 00
Nov.	2	To Corcoran & Riggs, on account of funds in their hands		10,000 00
Dec.	30	To Corcoran & Riggs, interest to December 31, 1854, on funds in their hands		3,401 39
		REPAYMENTS.		
Jan.	4	To sale of clock, on account of apparatus		400 00
	14	To Minnesota Historical Society, on account of Smithsonian Contributions		20 00
March	13	To Coast Survey office, on account of apparatus		560 92
		To Coast Survey office, on account of transportation		12 27
	17	To J. M. Gilliss, Navy Department, on account of transportation		16 62
July	29	To G. P. Putnam, sale of books, on account of Smithsonian Contributions		143 69
				123,140 03

the Smithsonian Institution. **Cr.**

EXPENDITURES.

1853.			
Dec.	31	By W. W. Seaton, treasurer	$5,220 00
			41,758 77
1854.			
Jan.	12	By W. W. Seaton, treasurer	15,455 07
	18	......do..............do	48,800 00
April	1	......do..............do	10,000 00
July	14	......do..............do	15,455 07
	21	......do..............do	3,875 00
Aug.	7	......do..............do	10,000 00
Sept.	25	......do..............do	5,000 00
Nov.	2	......do..............do	10,000 00
Dec.	30	......do..............do	3,401 39
Jan.	4	......do..............do	400 00
	14	......do..............do	20 00
March	13	......do..............do	560 92
	13	......do..............do	12 27
	17	......do..............do	16 62
July	29	......do..............do	143 69
			123,140 03

The committee, after conferring with the secretary, submit the following estimates for appropriations for the year 1855:

BUILDING, FURNITURE, ETC.		
Pay on contracts	$8,000 00	
Pay of architects, &c	500 00	
Incidental expenses to building	500 00	
Furniture and fixtures	1,000 00	
Magnetic observatory	20 00	
		$10,020 00
GENERAL EXPENSES.		
Meetings of Board	600 00	
Lighting and heating	850 00	
Postage	500 00	
Transportation and exchange	1,600 00	
Stationery	350 00	
General printing	250 00	
Apparatus	500 00	
Incidentals general	600 00	
Salaries—Secretary	3,500 00	
Clerk	1,200 00	
Book-keeper	200 00	
Janitor	400 00	
Laborer	250 00	
Watchman	365 00	
Extra clerk hire	200 00	
		11,365 00
PUBLICATIONS, LECTURES, ETC.		
Smithsonian Contributions	4,500 00	
Reports on progress of knowledge	2,000 00	
Other publications	500 00	
Meteorology	2,000 00	
Computations, researches, and investigations	500 00	
Lectures	1,000 00	
		10,500 00
LIBRARY, MUSEUM, AND GALLERY OF ART.		
Library—		
Pay of assistants	2,000 00	
Cost of books and binding	3,500 00	
Incidentals to library, cases, &c	1,000 00	
Stereotyping system	100 00	
	6,600 00	
Museum—		
Salary—Assistant secretary	2,000 00	
Explorations	200 00	
Alcohol, glass jars, &c	350 00	
Assistance and labor	100 00	
Incidentals, cases, &c	1,000 00	
Catalogue	250 00	
	3,900 00	
		10,500 00
Contingencies		100 00
		42,485 00

Respectfully submitted.

J. A. PEARCE,
A. D. BACHE,
J. G. TOTTEN,
Executive Committee.

JANUARY, 1855.

REPORT OF THE BUILDING COMMITTEE.

The building committee of the Smithsonian Institution presents the following report of their operations and expenditures during the year 1854.

It was stated in the last report that the work of completing the building was commenced by Mr. Gilbert Cameron, the original contractor, under the direction of Capt. Alexander, of the engineer corps, on the 13th of June, 1853. It has been uninterruptedly prosecuted from that time to the present, and the committee are now pleased to inform the Board that the main or centre building is finished, with the exception of a few and unimportant additions.

It was, however, discovered, in the progress of the work, that many changes and additions would be required, in the plan adopted, for the better security and adaptation of the building, which would involve an additional expense; but in the present state of the Institution, and in consideration of the long delay in finishing the edifice, the committee thought it best to press on the work.

The main building, which is 200 feet long, 50 feet wide, and 60 feet from the basement floor to the upper ceiling, is divided into three stories. The first story consists of the basement, separated into two large rooms, and the space between them for the heating apparatus. The two apartments are intended for store rooms and other purposes connected with the mechanical operations of the Institution.

The second story consists of one large room, 200 feet long, 50 feet wide, and 25 feet high, the ceiling of which is supported by two rows of columns extending the whole length; at the middle of the space corresponding to the principal entrances, are two wing walls, by which, with the addition of screens, the whole space may be divided into two large rooms, with a hall extending across the building between them. This story may be used for a library or a museum, or for both, as the wants of the Institution may require. It is finished in a simple but chaste style, and has received general commendation. Indeed it is, perhaps, in appearance, one of the most imposing rooms in this country, apart from adaptation to its purposes.

The floor through the middle part is formed of cut stone, that of the other parts is of wood, which, resting on the arches beneath, without space between to contain air, is considered sufficiently fire-proof, and not subject to dampness from the variation of temperature and humidity of the atmosphere.

The upper story is divided into three apartments without pillars, a lecture room of about 100 feet in length in the middle, and two rooms, each 50 feet square, on either side. These rooms are intended for collections. The one on the west may be connected with the library, and that on the east with the museum. The latter has been fitted up with cases in which to deposit the collection of apparatus presented to the Institution by Dr. Hare, the other with a separate case to contain

the personal effects of James Smithson. The lecture room, the optical and acoustic properties of which are probably unsurpassed by any apartment intended for the same purpose in the United States, occupies one-half of the upper story of the main building, besides a portion of the front and rear towers; its precise length is 96 feet, and extreme width 62 feet. It will comfortably seat 1,500 persons, and, when crowded, will contain upwards of 2,000. The apartments on each side of the lecture room, besides being fitted up with cases for books, specimens, or apparatus, can be used for meetings of associations, while large assemblies for public discussions can be accommodated in the lecture room.

The whole arrangement of the upper part of the building is made with a view to afford facilities for meetings of large associations which have for their object the promotion, diffusion, or application of knowledge. If at any time the space now occupied by the lecture room should be required for other purposes, the seats and gallery may be removed and the partition walls which are unconnected with the roof may be taken down and the whole upper story converted into one large hall. Besides the main building just finished, the whole edifice consists of two wings, two connecting ranges, and a front and rear projection at the middle on which towers are erected.

The whole amount paid on account of the building, the grounds, and furniture is $299,414 14. The amount paid during the past year is $55,021 14, of which $13,000 is on the work previously done under the direction of the former architect. In order to secure the faithful performance of the work, fifteen per cent. has been withheld from the monthly payments until the whole should be finished. The sum which, on this account, is still due to the contractor, has not yet definitely been ascertained. According to an addendum to the original contract, the Regents were at liberty to make any changes in the building or in the time of its completion which they might deem necessary, and the contractor should receive pro rata, according to the prices agreed upon, for work so executed, and reasonable compensation for damages which might be sustained.

The following letter from the architect will give additional information:

WASHINGTON, D. C., *December* 30, 1854.

GENTLEMEN: I have the honor to report to you that the work on your building has been prosecuted during the past year without intermission, and that the central portion of it is now nearly completed.

There are some small matters yet to be attended to, and a few trifling repairs and alterations yet to be made in the other parts of the building. These can all be completed in a few weeks.

I am happy to state that the building has been completed without any accident, either to the workmen employed, or to the building itself, and that in my opinion, every part of the work has been substantially done.

I have devoted much study to the plans which have been executed, and given the work my personal supervision nearly every day.

An examination of the rooms of the central building will impress one

with the idea of great simplicity. There is not much ornament, but still enough, as I think, to enable the building to do its duty with grace and dignity.

The lower hall is equally adapted to the purposes of a museum or a library. The lecture room is the best which it was possible to make within the walls of the building, and now that it has been completed, I am happy in being enabled to state that were it to be made over again, I would not alter any of its essential features.

I would not be doing justice to Professor Henry were I not to acknowledge the great assistance I have received from him in arranging the details of this room. I am free to confess that during the progress of the work he has given me suggestions which have materially improved my plans.

It will be seen by an examination of the payments which have been made to the contractor, that the cost of completing the building considerably exceeds the estimates which I prepared before the work was begun. This is due in part to the rise in the prices of materials and labor, but principally to the execution of many improvements which were not originally contemplated, but which it was thought best to make during the prosecution of the work. These improvements were the sewers for drainage; the cisterns for supplying water; the substitution of stone for iron stairs; the making of new sashes for many of the windows; the strengthening and in part re-construction of the roof of the main building, putting in copper gutter, and leaders on the towers, besides other alterations and additions tending to swell the cost of the work.

Hoping that my efforts to improve your building will meet you approbation, as well as that of the Board of Regents,

I am, gentlemen, very respectfully, your obedient servant,

B. S. ALEXANDER,
Architect Smithsonian Institution.

To the Building Committee of the Smithsonian Institution.

A full statement of the amount due the contractor cannot be given until a more precise estimate of all the items of work done under the direction of the architect has been made.

Respectfully submitted,

RICHARD RUSH,
WILLIAM H. ENGLISH,
JOSEPH HENRY,
Building Committee.

JOURNAL OF PROCEEDINGS

OF THE

BOARD OF REGENTS

OF

THE SMITHSONIAN INSTITUTION.

NINTH ANNUAL SESSION.

WEDNESDAY, January 3, 1855.

In accordance with a resolution of the Board of Regents of the Smithsonian Institution, fixing the time of the beginning of their annual meeting on the first Wednesday of January of each year, the Board met this day in the Regents' room.

Present: Messrs. Bache, Berrien, Douglas, Mason, Pearce, Rush, Towers, and the Secretary.

In the absence of the Chancellor Mr. Pearce was called to the chair.

The Secretary informed the Board of the re-election by joint resolution of Congress of Hon. Rufus Choate, of Massachusetts, and Hon. Gideon Hawley, of New York, as regents of the Smithsonian Institution for six years ensuing.

On motion of Mr. Mason the Board adjourned to meet on Friday, January 12, at 10 o'clock, a. m., and the Secretary was requested to inform the absent members of the Board that the report of the Select Committee on the distribution of the income would then be taken up for consideration.

FRIDAY, January 12, 1855.

An adjourned meeting of the Board of Regents of the Smithsonian Institution was held on Friday, January 12, at 10 o'clock a. m.

Present: The Chancellor, Roger B. Taney, Messrs. Bache, Berrien, Choate, Douglas, English, Hawley, Mason, Meacham, Pearce, Rush, Stuart, Totten, Towers, Professor Henry, Secretary, and Mr. Seaton, Treasurer.

The minutes of the last meeting were read and approved.

A communication from J. W. Simonton, Washington editor of the New York Daily Times, and S. Thayer, of the New York Evening Post, asking permission to attend the meetings of the Board to report its proceedings, was read.

Mr. Meacham moved that the request be granted, which was lost.

The order of the day being the consideration of the report and reso-

lutions of the Select Committee on the distribution of the income, the first resolution was read, namely:

Resolved, That the seventh resolution passed by the Board of Regents on the 26th of January, 1847, requiring an equal division of the income between the active operations and the museum and library when the buildings are completed, be and it is hereby repealed.

Remarks were made by Messrs. Choate, Pearce, Douglas, and Berrien.

On motion of Mr. Mason the yeas and nays were ordered.

The question was then taken on the adoption of the first resolution as follows:

YEAS.—The Chancellor, Roger B. Taney, Messrs. Bache, Berrien, Hawley, Mason, Pearce, Rush, and Totten—8.

NAYS.—Messrs. Choate, Douglas, English, Meacham, Stuart, and Towers—6.

The second resolution was then read:

Resolved. That hereafter the annual appropriations shall be apportioned specifically among the different objects and operations of the Institution in such manner as may, in the judgment of the regents, be necessary and proper for each, according to its intrinsic importance, and a compliance in good faith with the law.

The question being taken on this resolution it was adopted.

YEAS.—The Chancellor, Roger B. Taney, Messrs. Bache, Berrien, Hawley, Mason, Pearce, Rush, Totten, Towers—9.

NAYS.—Messrs. Choate, Douglas, English, Meacham, and Stuart—5.

Mr. Meacham then offered the following resolution, which was the first reported by him in his minority report, namely:

Resolved, That a compliance in good faith with the letter and spirit of the charter of the Smithsonian Institution, requires that a large proportion of the income of the Institution should be appropriated "for the gradual formation of a library composed of valuable works pertaining to all departments of human knowledge."

The question being taken on this resolution it was lost.

YEAS.—Messrs. Choate, Douglas, Meacham, and Stuart—4.

NAYS.—The Chancellor, Roger B. Taney, Messrs. Bache, Berrien, English, Hawley, Mason, Rush, Pearce, and Totten—9.

Mr. Meacham's second resolution was then read, namely:

Resolved, That the expenditures for the library shall be made under the direction of a "library committee" of three members, to be annually elected by the Board of Regents from members not upon the Executive Committee, or upon other committees which may be appointed to superintend the affairs of other departments or objects of the Institution.

The question being taken on this resolution it was lost.

YEAS.—Messrs. Choate, Douglas, and Meacham—3.

NAYS.—The Chancellor, Roger B. Taney, Messrs. Bache, Berrien, English, Hawley, Mason, Pearce, Rush, Stuart, and Totten—10.

On motion of Mr. Pearce the following resolution was adopted.

Resolved, That a committee of three be appointed by the Chancellor to confer with a Committee of the Establishment as to suitable means of communication between the two bodies, and to report thereon at a subsequent meeting of the regents.

The Chancellor appointed Messrs. Mason, Douglas, and Totten.

A communication from Gilbert A. Cameron was read; which, on motion, was referred to the Building Committee.

The Treasurer then made a statement of the condition of the finances of the Institution; which was referred to the Executive Committee.

The Board then adjourned to meet on Saturday, 13th January, at 10 o'clock.

SATURDAY, January 13, 1855.

An adjourned meeting of the Board of Regents of the Smithsonian Institution was held on Saturday, January 13, at ten o'clock, a. m.

Present: The Chancellor, Roger B. Taney, Messrs. Bache, Berrien, Choate, English, Hawley, Mason, Meacham, Pearce, Rush, Totten.

The minutes of the last meeting were read and approved.

Mr. Pearce, in behalf of the Executive Committee, presented the estimate of appropriations for the year 1855, which, on his motion, was laid on the table for the present.

Mr. Pearce, in behalf of the Executive Committee, presented the following report in relation to the case of Mr. Blodget, which had been referred to that committee by the Board.

REPORT.

At a meeting of the Board of Regents held Saturday, July 8, 1854, the Executive Committee was authorized to investigate and settle the business presented to the Board by the Secretary, in reference to the adjustment of the claims of Mr. Lorin Blodget.

The committee having investigated the matter referred to them, presents the following report in part:

Mr. Blodget was employed by the Secretary of the Institution to aid him by such labors in relation to the meteorological observations under the direction of the Smithsonian Institution as the Secretary might assign. The rates of compensation for these services were fixed from time to time by the same officer, and Mr. Blodget is entitled to no other compensation than that paid to him. His footing in the Institution was simply that of a temporary employé of the Secretary, in whose hands rested the determination of his duties, pay, and duration of service. Employed and paid for these services in connexion with the meteorological operations, the fruit of his labors belong exclusively to the Institution.

In addition to these payments the committee is prepared on receiving satisfactory statements or vouchers from Mr. Blodget of reasonable expenses incurred during any journeys he may have made with the consent of the Secretary for objects connected with his duties in meteorology in the Institution, to refund the amount, as also any moneys which may appear to the satisfaction of the committee to have been paid out by him and not already repaid for clerical or other services connected with the meteorological observations of the Smithsonian Institution, and for which an equivalent advantage has been recived.

J. A. PEARCE,
JOS. G. TOTTEN, } *Executive Committee.*
A. D. BACHE,

Communications and a memorial from Mr. Blodget to the Board were then read and ordered to lie on the table.

The report of the Executive Committee was then adopted unanimously.

It being stated to the Board by Mr. Choate on behalf of Mr. C. C. Jewett that he did not design, for reasons stated by him, to ask the action of the regents at their present meeting on his memorial of the 3d July last, communicated to the Board through the Secretary, Mr. Mason moved that the said paper be returned by the Secretary to Mr. Jewett.

On motion the memorial to the Board was then read.

Mr. Choate then requested permission in behalf of Mr. Jewett to withdraw the memorial, which was granted.

The Secretary then stated to the Board that he had deemed it his duty since its last session to remove Mr. Charles C. Jewett from the office of assistant to the Secretary. He deeply regretted the necessity which he had been under to exercise this authority, declared to be vested in him by the Board, and for the present he rested his reasons for the act on the character of a paper submitted by Mr. Jewett to the select committee on the distribution of the income, and upon the opinion in regard to that paper expressed by the committee to which it was submitted.

Mr. Pearce offered the following:

The Secretary having stated to the Board that since the last meeting of the Regents in 1854 he had removed Mr. Jewett, under the authority declared to be vested in him by the resolution of July 8, 1854.

Resolved, That while the Board regret the necessity of Mr. Jewett's removal, they approve of the act of the Secretary.

Resolved, That this approval by the Board is not deemed by them to be essential to the validity of the act of the Secretary in so removing Mr. Jewett.

The Board then adjourned to meet on Monday, January 15, at ten o'clock.

MONDAY, January 15, 1855.

The Board of Regents met to-day at ten o'clock.

Present: The Chancellor, Roger B. Taney, Messrs. Bache, Berrien, Douglas, Hawley, Mason, Pearce, Rush, Towers and Totten.

The Chancellor, took the chair, and the minutes of the last meeting were read and approved.

Mr. Pearce's resolutions offered at the last meeting on Saturday were then taken up.

The question being taken on the first resolution, it was adopted. Yeas.—The Chancellor, Roger B. Taney, Messrs. Bache, Berrien, Hawley, Mason, Pearce, Rush, Totten—8.

Nays.—Messrs. Douglas, Towers—2.

The second resolution was then taken up and adopted.

Yeas.—The Chancellor, Roger B. Taney, Messrs. Bache, Berrien, Hawley, Mason, Pearce, Rush, Totten—8.

Nays.—Messrs. Douglas, Towers—2.

On motion of Mr. Rush, Mr. John T. Towers was elected to fill the vacancy in the Building Committee.

The report of the Executive Committee, making estimates of appropriations for the year 1855, &c., was then taken up and adopted.

On motion of General Totten, the following resolution was adopted:

Resolved, That in case the sum required for the completion of the Smithsonian building should exceed the amount appropriated for the same, that the Building Committee have authority to pay for any unavoidable excess out of funds on deposit to the credit of the Institution.

The report of the Building Committee was then read, and on motion adopted.

A memorial and printed pamphlet from John Lord, of Portland, Maine, was read and ordered to lie on the table.

The Board then adjourned to meet on Saturday, January 27, at ten o'clock a. m.

WASHINGTON, *January* 27, 1855.

An adjourned meeting of the Board of Regents of the Smithsonian Institution was held on Saturday, January 27, 1855, in the regents' room.

Present: The Chancellor, Roger B. Taney, Messrs. Bache, Pearce, Stuart, Towers, Totten.

The minutes of the last meeting were read and approved.

The following communication was read:

HOUSE OF REPRESENTATIVES,
Washington, January 26, 1855.

SIR: I am instructed by the special committee of the House of Representatives, raised in conformity with the accompanying resolution, to request you to inform the Board of Regents of the Smithsonian Institution that the committee is ready to proceed to the discharge of its duties—and that any communication the Board may think proper to make will be most respectfully entertained.

The committee will meet on Thursday, February 1, at half past 7 o'clock, p. m., in the rooms of the Hon. W. H. Wittee, at the National Hotel.

The presence of an authorized representation of the Board, during the investigation of the matters referred to the committee, would aid us in the performance of the duty imposed by the order of the House of Representatives.

Very respectfully, your obedient servant,
CHARLES W. UPHAM, *Chairman*.

Professor JOS. HENRY,
Secretary of the Smithsonian Institution.

Copy of resolution of House enclosed.

IN THE HOUSE OF REPRESENTATIVES U. S.—*January* 17, 1855.

On motion of Mr. Meacham,

Resolved, That the letter of Hon. Rufus Choate, resigning his place as Regent of the Smithsonian Institution, be referred to a select committee of five, and printed; and that said committee be directed to

inquire and report to this House whether the Smithsonian Institution has been managed, and its funds expended, in accordance with the law establishing the Institution; and whether any additional legislation be necessary to carry out the designs of its founders, and that said committee have power to send for persons and papers.

The Speaker thereupon appointed Mr. Upham, of Massachusetts; Mr. Witte, of Pennsylvania; Mr. Taylor, of Tennessee; Mr. Wells, of Wisconsin; and Mr. Puryear, of North Carolina, the said committee.

On motion of Mr. Pearce, it was—

Resolved, That a committee of five be appointed by the Chancellor to represent the Board of Regents before the committee of the House of Representatives.

The Chancellor appointed Messrs. Pearce, Mason, Bache, Rush, and the Secretary, as the committee.

The Secretary laid before the Board his annual report.

Communications, and a bill of charges from Lorin Blodget, were read, and, on motion of Mr. Stuart, referred to the Executive Committee.

Communication from G. Cameron, the contractor for the building, was read, and referred to the Building Committee.

Communication from J. M. Stanley, artist, offering to dispose of his Indian Gallery, was read, and, after remarks, on motion it was—

Resolved, That the Secretary be instructed respectfully to decline the offer made to the Board by Mr. Stanley.

A communication relative to the Geographical and Commercial Gazette was read, and referred to the Executive Committee.

The Board then adjourned to meet on Saturday, February 10, at 10 o'clock, a. m.

WASHINGTON, *February* 10, 1855.

Present: Messrs. Bache, Mason, Pearce, Totten, and the Secretary

There being no quorum, adjourned to Saturday, February 17.

WASHINGTON, *February* 17, 1855.

Messrs. English, Pearce, Totten, Towers, and the Secretary present.

There being no quorum, adjourned to meet on Saturday, February 24.

WASHINGTON, *February* 24, 1855.

An adjourned meeting of the Board of Regents was held on Saturday, February 24, 1855, at 10 o'clock a. m.

Present: The Chancellor, Roger B. Taney, Messrs. Bache, Douglas, English, Pearce, Totten, Seaton, treasurer, and the Secretary.

A report entitled "Report of the Hon. James Meacham, of the special committee of the Board of Regents of the Smithsonian Institution, on the distribution of the income of the Smithsonian fund," &c., was presented, and on motion laid on the table.

On motion of Mr. English, the following resolution was adopted:

Resolved, That three persons be appointed a committee of finance, who shall inquire into the safety and propriety of the present invest-

ment of the funds of the Institution, not in the Treasury of the United States, and who shall have the authority to withdraw the said fund from the present place of deposit, and invest them otherwise in the name of the regents of the Institution.

The chancellor appointed Messrs. English, Pearce and Mason as the committee.

The following report was read:

The committee to whom was referred the resolution of the "establishment," proposing a conference by committee with the Board of Regents, for the purpose of determining the mode of communication between the establishment and the Board of Regents, submit the following report:

That they have met and conferred with the committee appointed for that purpose by the establishment, and have, after consultation, agreed upon the following resolutions, to be reported by the committees to their respective constituencies, and the committee recommend that they be adopted by the Board of Regents, and made a part of the by-laws.

1. The general communication between the Institution and the Board of Regents shall be made through their common secretary.

2. The secretary will regularly communicate to each body all such acts of either as may concern the other respectively, or may require their joint action.

3. When either body may desire any special communication with the other, it will propose a conference by committee.

All which is respectfully submitted.

J. M. MASON, *Chairman.*

JANUARY, 1855.

The report of the committee was approved.

The following resolution was offered by Mr. Douglas, and adopted by the Board:

Resolved, That all correspondence of this Institution with any person or society shall be conducted by the Secretary, and no assistant or employee shall write or receive any official letter or communication pertaining to the affairs of the Institution, except under the authority and by the direction of the Secretary, and all such correspondence shall be duly registered and recorded in such manner as the Secretary shall direct.

The Board then adjourned to meet at the call of the Secretary.

APPENDIX

TO THE

REPORT OF THE REGENTS

OF THE

SMITHSONIAN INSTITUTION.

Report on American Explorations in the years 1853 *and* 1854. *By S. F. Baird, Assistant Secretary of the Smithsonian Institution.*

The report on this subject for 1853, though ready for publication at the time of printing the last Annual Report of the Smithsonian Institution, was kept back until the present year, as most of the expeditions mentioned in it were still in the field at the close of 1853, and of many no definite intelligence had been received. Nearly all of these have, however, returned; and their officers are now busily engaged in preparing their reports. I therefore shall present the principal events for 1853 and 1854 in one narrative, without always distinguishing those of each year.

The number of important scientific explorations embraced in this period, mark it conspicuously in the history of American discovery. Most of these are due to the appropriation for the survey of the China seas and Behring's Straits, and that for a survey of the several routes for a railroad to the Pacific, (although many more private expeditions were set on foot,) in addition to the regular operations of the United States and Mexican Boundary Survey, whose labors during the past years were in continuation of those commenced before. Many reports of explorations, commenced or completed prior to 1853, have been published during this period, and will be noticed in their proper places.

With scarcely an exception, every expedition of any magnitude has received more or less aid from the Smithsonian Institution. This has consisted in the supplying of instructions for making observations and collections in meteorology and natural history, and of information as to particular desiderata; in the preparation, in part, of the meteorological, magnetical, and natural history outfit, including the selection and purchase of the necessary apparatus and instruments; in the nomination and training of persons to fill important positions in the scientific corps; in the reception of the collections made, and their reference to individuals competent to report upon them; and in employing skillful and trained artists to make accurate delineations of the new or unfigured species. Much of the apparatus supplied to the different parties was invented or adapted by the Institution for this special purpose, and used for the first time, with results surpassing the most sanguine expectations

I shall now proceed to present such facts as may be necessary to a full understanding of the history and progress of these several expeditions, considering first those having North America for their field.

United States and Mexican Boundary Survey.

The operations on the eastern end of the boundary line, as originally established, were brought to a successful termination towards the end of 1853, by the energy and skill of Major Emory, and all the parties returned to Washington by the beginning of 1854. After the purchase of a portion of Sonora from Mexico, it became necessary to make a new survey of the Mexican boundary; and Major Emory having been appointed commissioner, he completed his preparations in a very short time, and proceeded to the field of his labors, arriving at El Paso, the initial point, the beginning of December, 1854. From this point he will proceed westward, expecting to meet half-way the sub-party of Lieutenant Michler, who starts eastward from Fort Yuma. Major Emory is accompanied by Dr. Kennerly as surgeon and naturalist, from whom much may be expected in the development of the natural history of the country, with the facilities which Major Emory has always furnished to the scientific corps of his several explorations. The natural history collections brought back from the lower Rio Grande, by Major Emory, were very extensive and important.

Survey of routes for a Railroad to the Pacific.

Just before the adjournment of Congress, in March, 1853, an appropriation of $150,000 was made, to defray the expenses of the survey of various routes along which it was supposed that a railroad, extending between the Mississippi river and the Pacific, might be constructed. By virtue of the authority committed to him by Congress, the Secretary of War proceeded to organize six parties, for the exploration of four main routes leading to the Pacific; and of these, Gov. I. I. Stevens, Lieutenant R. S. Williamson, Captain Gunnison, Lieutenant A. W. Whipple, and, at a later period, Lieutenant J. G. Parke and Captain J. Pope, were severally placed in command. All these parties were abundantly provided with the apparatus and instructions, written or printed, necessary to enable them to make copious collections in natural history, and observations in physical science. Each party (excepting the two last, which were not so fully organized) went accompanied by a surgeon, zoölogist, botanist, mineralogist, geologist, and a civil engineer; though, occasionally, the same person united several of these functions. The parties set out for their several labors in the following order and organization.

1. *Northern route under Governor I. I. Stevens.*

This portion of the survey was first in the field and most extensive in its organization. It was placed under command of Governor I. I. Stevens, lately of the corps of the United States engineers, and assistant in charge of the Coast Survey, who had been appointed governor

of the new Territory of Washington, and was now about proceeding to the field of his duties. The survey was divided into two main bodies, one to proceed towards the Rocky mountains from the east, the other to cross the isthmus and start in from the Pacific side to meet the former. Each of these parties was again subdivided into sub-parties, the progress and superintendence of which is as follows:

Governor Stevens, with the main party, proceeded from St. Paul, on the 8th of June, 1853, westward to Fort Union, a trading post belonging to the American Fur Company, situated at the mouth of the Yellow Stone river; thence up the Missouri river to the mouth of Milk river; and up the valley of Milk river, nearly due west, to Fort Benton, another trading post of the American Fur Company near the Falls of the Missouri, where they arrived September 1.

From Fort Benton Governor Stevens crossed to the mission of St. Mary's; thence, by the Cœur d'Alene, to Fort Colville; thence to Fort Vancouver and Olympia.

Lieutenant Saxton started from Fort Vancouver, and proceeded up the Columbia river, by water, as far as the Dalles; from the Dalles, up the valley of the Columbia, by land, to Walla-walla, a trading post occupied by the Hudson's Bay Company; thence in a northeasterly direction to the western extremity of Kalispe lake, crossing Lewis's fork of the Columbia, forty miles from Walla-walla, and Clarke's fork, near the outlet of Kalispe lake; thence along the northern shore of this lake and Clarke's fork of the Columbia, in a southeasterly direction, recrossing the river near the mouth of the Bitter Root, one of its branches; and thence nearly due south to the Flathead village of St. Mary's, situated on the St. Mary's fork of the Bitter Root, thirty miles south of the mouth of the Hellgate river. He proceeded up the valley of the Hellgate or Blackfoot river and the Foospinney, one of its branches, to the Blackfoot pass in the Rocky mountains. This pass is situated about ninety miles from Fort Benton, near the sources of the Teton and Medicine rivers. He crossed the mountains through this pass, and met Governor Stevens and his party at Fort Benton. From Fort Benton he went down the Missouri river to St. Louis—in a keel-boat as far as Fort Leavenworth.

Lieutenant Donelson, with the main party, passed over Lieutenant Saxton's route from Fort Benton to Fort Vancouver. Dr. Suckley went down the river, from St. Mary's valley, in a canoe, from the Flathead village to Fort Colville. Captain McClellan explored the country on both sides of the Cascade range northward from Vancouver; he met Governor Stevens's parties at Fort Colville, and then continued his expedition as far north as our northern boundary line. Lieutenant Mullen went from Fort Benton to St. Mary's village by the Jefferson fork of Missouri. He remained at St. Mary's village during the winter, continuing his explorations as far north as the Flathead lake, and southward to Fort Hall. After continuing in the mountains for nearly a year, he returned to Olympia in the winter of 1854–'55. Lieutenant Macfeely returned from St. Mary's village to Fort Vancouver by the southern Nez Percé trail down the valley of Kooskooskie and Little Salmon rivers. Mr. Tinkham, civil engineer, accompanied Governor Stevens's party as far as St. Mary's village, and recrossed the Rocky mountains to Fort

Benton, and surveyed the Marias pass, situated to the north of the Blackfoot or Cadot's pass, and proceeded to Olympia, Washington Territory, by a new route through some pass in the Cascade mountains. Lieutenant Grover was to make an accurate survey of the Missouri river from the Falls to the mouth of the Yellow Stone, and then across the Rocky mountains, in mid-winter on snow shoes, by the route Lieutenant Saxton followed. His object was to test the climate in the mountains during the most unfavorable season of the year. Mr. Doty was left at Fort Benton to make meteorological and other observations during the winter. He remained until the autumn of 1854, when he proceeded to Washington Territory, and joined Governor Stevens.

Most of these parties were provided with the means of making observations and collections in natural and physical science, and all have faithfully carried out their instructions.

Dr. Suckley, surgeon and naturalist to the main party, accompanied Governor Stevens as far as the Flathead village, and thence down the river, as described.

Dr. J. G. Cooper acted in the same capacity in connexion with Captain McClellan's expedition. Both these gentlemen, aided by the officers and assistants of the command, were occupied the whole time in making extensive collections of the highest interest. Lieutenant Donelson, with the party under his command, in proceeding up the Missouri to Fort Union, spared no exertion to accomplish the same object, and gathered a large collection of plants and of specimens in alcohol.

Dr. Evans, United States geologist for Oregon, accompanied by Dr. B. F. Shumard, visited the Mauvaises Terres of Nebraska, in connexion with Governor Stevens's exploration, and collected a very extensive series of the fossil mammals and chelonians of that region, embracing several species not previously found by him. He arrived in Oregon late in 1853, and has since been engaged in completing his regular explorations of the geology of Oregon and Washington, with very important results.

Since the completion of the survey, Dr. Suckley and Dr. Cooper have continued their explorations most energetically. The former spent several months at Steilacoom, on Puget's Sound, as United States surgeon of the post, and then went to the Dalles, from which point he accompanied a party sent to Fort Boisé, to chastise some Indians. Dr. Cooper has been most of his time at Shoal-water bay. Both of these gentlemen have collected and sent home, from their respective stations, very valuable and extensive series of animals and plants, with important notes on their habits and peculiarities.

2. *Survey of the route near the 38th parallel, under the late Captain Gunnison, and continued by Lieutenant Beckwith.*

The party of Captain J. W. Gunnison originally consisted of himself in command, Lieutenant E. G. Beckwith, commissary and quartermaster; R. N. Kern, topographer and draughtsman; J. H. Peters and T. L. Homans, assistant engineers; Dr. Scheel, surgeon and mineralogist; F. Kreutzfeldt, botanist and draughtsman; together with an escort

of thirty men, commanded by Captain Morris, United States rifles. The party was organized at camp Shawnee Reservation, on the 20th of June, and proceeded up the Sandy Hill fork of the Kansas, and then across to the Arkansas, and up to the Abispah. After exploring this region, they crossed over on the Trincheres, and next to the Huerfano, thence across the mountains to the head of the Sangre del Cristo Pass, and down the valley of this stream to Fort Massachusetts. From this point they passed up the valley of San Luis, through Cooachotope pass, and down to Grand river of the Colorado; along it, past the Uncompagre and Aoonakara. Beyond this they struck the old Spanish trail, and after crossing Green river left it and passed through Wahsatch pass, for Sevier river, and down this river nearly to Sevier lake. While exploring the regions about this lake, nearly the whole of the scientific corps, consisting of Captain Gunnison, Mr. Kern, Mr. Kreutzfeldt, and several other persons, were surprised by a party of the Pah Utahs, on the morning of the 26th of October, 1853, and all put to death. Science has much to deplore in the loss of these gentlemen, all so well known previously for their intrepid zeal as explorers: Captain Gunnison, in connexion with Captain Stansbury's survey of Great Salt Lake; and Mr. Kern as the companion of Colonel Frémont, Captain Simpson, Captain Sitgreaves, Lt. Parke, and others. Mr. Kreutzfeldt was also a member of the memorable party of Colonel Frémont, which met with such sad disasters in the region of his latest exploration.

Most of the instruments and papers of the party were captured by the Indians, but afterwards given up; and the command devolving on Lieutenant Beckwith, he spent the winter at Salt Lake city, and in the spring of 1854 proceeded across to California by a new route. He returned in September, and is now engaged in completing his report. He brought with him a valuable collection of specimens.

3. *Survey of the route near the 35th parallel of latitude, under Lieutenant Whipple.*

The third railroad party was commanded by Lieutenant A. W. Whipple, formerly connected with the survey of the Mexican boundary. His party consisted of Lieutenant J. C. Ives, principal assistant; Dr. J. M. Bigelow, surgeon and botanist; Jules Marcou, geologist; Dr. C. B. R. Kennerly, surgeon and zoölogist; H. B. Möllhausen, topographer and artist; Hugh Campbell, astronomer; Albert H. Campbell, engineer; together with Messrs. White, Garner, Hutton, Sherburne, and Parke. Lieutenant Ives, with Dr. Kennerly and Mr. Hugh Campbell, were detailed to go by Indianola and San Antonio, to El Paso, for the purpose of securing certain instruments left there, after which they joined Lieutenant Whipple at Albuquerque. The main party went from Fort Smith mainly up the Canadian, and across the Llano Estacado, to Anton Chico. Here it divided, Mr. Albert Campbell, with the main party, proceeding directly to Albuquerque, *via* Laguna; Lieutenant Whipple pursuing a somewhat different route; and all the parties, including that of Lieutenant Ives, meeting at Albuquerque, on the 26th of October. From Albuquerque they went over to the Little Colorado, *via* the Pueblo of Zuñi; next by way of the San Francisco

mountains to Bill Williams's fork; down this stream to the Colorado, then up the Mohave, and across to San Francisco. The party returned to the United States in April, 1854, with the exception of Dr. Bigelow, the botanist, who remained a few months longer exploring the Sierra Nevada.

The collections in every department were very large, and included many new and rare species.

4. *Survey of the several partial routes on the Pacific side under Lieutenant Williamson.*

The fourth of the principal government parties for the survey of the Pacific railroad route is that of Lieutenant R. S. Williamson, accompanied by Lieutenant J. G. Parke as assistant, William P. Blake as geologist, and Dr. A. L. Heermann as surgeon and naturalist, together with a skillful artist and civil engineer. The escort was commanded by Lieutenant Stoneman. The party started from San Francisco and passed up the San Joaquin and Tulare valley, and explored the region about Walker's Pass, and along the Mohave over to the Colorado. They also examined the Tejon Pass, the Canada de las Uvas, the Cajon, the Gorgona and Caliente passes of the coast range. Lieutenant Williamson returned in the latter part of 1854, and is now engaged in preparing his report, to include notices of many interesting collections in natural history.

5. *Survey near the 32d parallel of latitude, western end, under Lieutenant Parke.*

After the completion of the survey of Lieutenant Williamson, Lieutenant Parke, accompanied by Lieutenant Stoneman and Dr. Heermann, started from San Diego in January, 1854, and proceeded by way of Warner's Ranch to camp Yuma at the mouth of the Gila, and thence up this river to the Pima and Maricopa villages, thence to Tucson, Fort Webster, Doña Ana and Trentera. This point was reached on the 24th of March, the entire distance from San Diego having been traversed with wagons in about sixty days. Here the exploration terminated, and the party proceeded rapidly home *via* San Antonio, reaching Washington in May, 1854.

In October, 1854, Lieutenant Parke again returned to California for the purpose of making further surveys. He was accompanied by Mr. Albert H. Campbell, civil engineer; Dr. Antisele, surgeon and geologist; H. Campbell, G. G. Garner, and N. H. Hutton, assistants. Lieutenant Parke will organize his expedition at Benicia, with all possible dispatch, and proceed to explore the Salinas river, from the Bay of Monterey to its sources, with a view of finding a practicable passage through the coast range into the Mohave basin, or into the valley of Los Angeles. Further examinations will also be made of the Mohave river, in the vicinity of the Colorado, on Lieutenant Whipple's route. Returning thence, this party will start from San Diego and go across to El Paso, on the Rio Grande, by the route south of the Gila.

6. *Survey near the 32d parallel of latitude, eastern end, under Captain John Pope.*

Captain Pope, accompanied by Lieutenant Garrard, Captain Taflin, and Dr. Diffenderfer, with an escort under the command of Lieutenant Marshall, left El Paso on the 20th of February, for Preston, Texas, for the purpose of completing the survey of the 32d parallel, prosecuted at the western end by Lieutenant Parke. The line followed was nearly straight except through the Guadalupe mountains. The Pecos was passed near the mouth of Delaware creek, and the Llano Estacado traversed for a distance of one hundred and twenty-five miles. From this the party proceeded *via* head waters of Brazos and Colorado, arriving in Preston about the middle of May. The natural history collections made were very extensive and valuable, including, as they did, a portion of those gathered by Dr. T. C. Henry, U. S. A., in New Mexico, during a period of several years. Captain Pope has since returned to the Llano Estacado, for the purpose of experimenting upon Artesian borings in the desert. He is accompanied by Dr. G. G. Shumard, as surgeon and geologist, well known in connexion with explorations by Captain Marcy.

Exploration of Colonel Frémont.

In order to test the depth of winter snow along the central route traversed by Captain Gunnison and Messrs. Beale and Heap, Colonel Frémont started late in the season, and on the 25th of November was still below the mouth of the Huerfano. Entering the mountain region on the Huerfano on the 3d of December, he emerged from it, and reached the Little Salt settlement on the 9th of February, having found but four inches of snow in the Coochetope Pass on the 14th of December. From Parowan he proceeded to San Francisco, and has since then been engaged in preparing a report on the results of his trip.

Expedition of Messrs. Beale and Heap.

Lieutenant E. F. Beale, superintendent of Indian affairs in California, about to return to the scenes of his philanthropic labors among the Indians, in the vicinity of Tejon Pass, embraced the occasion to make the journey over land by the central route. He was in company with Mr. G. H. Heap. They left Westport, Missouri, on the 6th of May, and proceeded to Fort Atkinson on the Arkansas, crossing the head waters of the Osage and the Neosho. From this point they passed up the Arkansas to the Huerfano, and proceeded to the Mormon settlements near Little Salt lake and the vegas of Santa Clara, very nearly on the route pursued by Captain Gunnison, excepting that they went up the Huerfano instead of the Abispah. From the vegas they pursued the old Spanish trail leading from Abiquiu across the desert of the Mohave, and thence to Los Angeles, where they arrived on the 22d of August, making a distance of 1,852 miles from Westport in 100 days. Some of the party had travelled 715 miles more in going to Taos and back, in consequence of the loss of stores. The party was at one time in

imminent danger of collision with the same band of Indians that afterwards massacred Captain Gunnison.

J. Soulé Bowman.

Mr. Bowman left Kansas the 20th of May, 1853, on his journey to California, and travelling up the Kansas river crossed it at the Baptist mission, and proceeded to Salt Lake city, *via* Fort Kearney and Fort Laramie. Leaving Salt Lake city on the 29th of July, he proceeded to Humboldt river, passing down its north side to the sink. From the sink he took the Truckee river route, and thence, by Beckwith's cut off to Bidwell's bar and Marysville. Shortly after his arrival in San Francisco he was attacked with the typhoid fever, which carried him off in a few days. Mr. Bowman's untimely end is greatly to be lamented, not only as a citizen, relative, and friend, but as a man of science. For many years he has embraced every opportunity for making collections in natural history, even under the most unfavorable circumstances.

In a previous report I have referred to a collection made for the Institution by Mr. Bowman. Those gathered by him during the trip just referred to were of much greater extent, embracing quite a full series of fishes and reptiles from a previously unexplored region—many new to science and all in excellent condition. These were received in April, 1854, through the kind assistance of his brother, S. M. Bowman, of San Francisco, and of Lieutenant Whipple.

Exploration of the Brazos, by Captain R. B. Marcy.

Captain Marcy, having completed and published his report of an exploration of Red river in 1852, was detailed in 1854 to select and survey certain lands in Texas, donated by that State for the benefit of the Indian tribes included within her limits. He accordingly left New York for this purpose in May, and proceeded to Fort Belknap, near which the reservation is situated. Accompanied and assisted by Major Neighbors, Indian agent, he performed the duty assigned him, and from interviews with the chiefs of the southern Comanches, found that these Indians were not averse to the idea of settling down permanently and cultivating the soil.

In the course of the summer Captain Marcy visited the head waters of the Brazos and the Big Witchita, a region previously untrodden by the white man. During his entire trip he was accompanied by Dr. G. G. Shumard, as surgeon and naturalist, who made extensive and valuable collections and observations, which will be embodied in the report of Captain Marcy.

Lieutenant D. N. Couch.

In the winter of 1852–'53, Lieutenant Couch, of the United States artillery, under leave of absence from the War Department, left Washington for the purpose of making explorations in the natural history and geography of Mexico. After a short stay at Brownsville, accompanied

by several servants, he crossed the river into Mexico, and went first to Monterey in New Leon. Here he spent some time in examining the Sierras south and west of that city, and thence proceeded to Parras in Coahuila, 185 miles west of Monterey. He went next to the plains of the lower Bolson de Mapimi, Durango, visiting there the celebrated Durango caves. Owing to the desertion of some of his attendants, he was unable to extend his journey further west, and retrac ng his steps he explored the salt plain of Alamo de Parras before returning to the United States by his original route.

During the whole of this journey Lieutenant Couch gathered copious collections in all departments of zoology, and made a large number of original notes upon the habits of the species. Many new species were obtained by him, and important discoveries made respecting the geographical distribution of others. A portion of the results thus secured have been published by Lieutenant Couch, and others may shortly be expected.

When in Matamoras Lieutenant Couch purchased the entire collection of notes and specimens left by Doctor L. Berlandier. This was the result of many years of labor in the province of Tamaulipas, and proved to be of extraordinary value.

Count Cypriani.

According to Mr. Heap, Count Cypriani, ex-Governor of Leghorn, left Westport in May, 1853, for a trip to California, *via* Fort Laramie and the South Pass, Great Salt Lake, and Carson's Valley. His party consisted of eleven scientific men and a sufficient escort, well provided with all means of scientific research. No information has yet been received of the further movements of this party.

Explorations of S. F. Baird.

By authority of the Secretary of the Smithsonian Institution, Mr. Baird, during the summer of 1853, proceeded in company with Dr. J. P. Kirtland, of Cleveland, to Racine, Wisconsin, where they spent a week in exploring the streams and prairies in its vicinity, with the assistance of Dr. P. R. Hoy and Rev. A. C. Barry, well known naturalists, resident in that place; and with them next visited the interior of the State, spending some time at Madison, and returning *via* Milwaukie. Dr. Kirtland and Mr. Baird next visited Ohio, spending some days at Elyria, and a week at Poland, Ohio. From Poland they went to Detroit, where they were joined by Professor Charles Fox and Dr. Davenport, with whom they visited Ann Arbor and Port Huron, exploring, in addition, a considerable extent of Detroit river. Mr. Baird next went alone to Montreal, and down the river below Quebec, then back again to Lake Champlain. The principal result of this trip covering over 5,000 miles, was the acquisition of very full sets of the fishes of the lake basin over a water line of about 1,500 miles, serving to develope important facts in regard to their geographical distribution. A complete series of the fishes of Ohio, as described by Dr. Kirtland in his "Fishes of the Ohio," was also secured from the original localities.

and identified on the spot by this distinguished naturalist. The entire collection of fishes and other alcoholic specimens filled twelve kegs and large cans. In 1854, Mr. Baird visited the coast of New Jersey, and spent six weeks in the vicinity of Beeseley's Point, at the mouth of Great Egg Harbor river, studying the habits and collecting specimens of the marine species. A full account of the results of this trip will be found in the present report. Additional explorations of similar character, were made at Greenport and River-head, Long Island, as also near Piermont and Sing Sing, on the Hudson river. At Piermont he had the valuable aid of Mr. John G. Bell, of New York, in collecting full series of the fish of the Hackensack and Sparkill, embracing several species new to the State, and others heretofore only found in that locality.

Exploration in Western Missouri and Kansas, by Dr. P. R. Hoy.

Dr. Hoy, well known as an ardent and successful naturalist of Racine, Wisconsin, left that place on the 4th of April, 1854, for a natural history excursion to Missouri. Stopping at various points to make collections, he reached St. Louis on the 12th, and next day proceeded up the Missouri river. After a short stay at Boonville, Cooper county, Missouri, he went on to Lexington, Missouri, and from this point made various excursions, some of them into Kansas; after remaining in this region some time, Dr. Hoy returned to Racine in June. Availing himself of every opportunity to add to his collections, Dr. Hoy gathered together many species of birds, reptiles, and fishes; among the latter quite a number new to science. One hundred and fifty-two species of birds were observed, or obtained by him above Boonville alone, some of them not previously known to occur so far to the east. His alcoholic collections have been sent to the Institution, and prove to be of great interest.

Exploration of Northern Wisconsin, in 1854, *by Rev. A. C. Barry.*

Mr. Barry left Racine on the 10th of May, 1854, for his trip through northern Wisconsin, and reached Oshkosh, *via* Sheboygan and Fond du Lac, on the 13th. His route thence was up the Fox, to Lake Butte des Morts; thence up the Wolf, to the junction of the Waupacca; thence to the mouth of the Embarras, and across the country to the Wisconsin, striking the river at Plover Portage. From this point he passed down the Wisconsin river, examining the country and streams on both sides as far as Richland city; returning by way of Dodgeville, Madison, Palmyra, East Troy, and Rochester, to Racine, where he arrived towards the end of June. In the course of his journey, Mr. Barry made copious notes of his observations, which will be hereafter presented to the Institution. The numerous collections of fishes and reptiles made by him have already been received, and were gathered principally in the following localities:

Lake Winnebago, Lake Butte des Morts, Waupacca river, Little Waupacca, Embarras river, Spring brook, Baird's lake, Wisconsin river, Lemmonwier river, Yellow river, Bear creek, Pine river, Green creek, Little Plover, Big Plover, and Carp lake.

Exploration and Survey of the China Seas and Behring's Straits.

In the summer of 1852, Congress made an appropriation of $125,000 for "building or purchase of suitable vessels and for prosecuting a survey and reconnoisance for naval and commercial purposes, of such parts of Behring Straits of the North Pacific ocean and the China seas as are frequented by American whale ships, and by trading vessels in their routes between the United States and China." The act was passed at too late a period in the year to allow any action beyond the organization of the party, and the commencement of preparations for departure. The command of the expedition was entrusted by the Secretary of the Navy, Hon. John P. Kennedy, to Captain C. Ringgold, an officer of much experience in the duties required, from his connexion with the United States exploring expedition under Captain Wilkes. The necessary vessels were procured and equipped in the most substantial manner, and fitted out with all the instruments required for making observations in astronomy, hydrography, magnetism, meteorology, together with the most complete equipment of natural history apparatus ever taken to sea. The expedition was fortunate in securing the services of Mr. William Stimpson as principal zoologist, and Mr. Charles Wright as botanist, both of them gentlemen well known for successful prosecution of their respective departments in former explorations. Mr. F. H. Storer went out as chemist and taxidermist, and E. M. Kern, the intrepid companion of Frémont and Sitgreaves, as artist and photographer. Many of the naval officers on board expected to lend efficient aid in the natural history department as well as in the physical, to which they are more especially assigned.

The squadron, as finally organized, consisted of the following vessels:

1. *The sloop Vincennes*, bearing the flag of Commander Ringgold, with Lieutenant Rolando as lieutenant commanding and executive officer; Lieutenant J. M. Brooke, acting lieutenant and assistant astronomer; William B. Boggs, purser and artist; Frederick D. Stuart, secretary and draughtsman; William Stimpson, zoologist to expedition; F. H. Storer, chemist and taxidermist, and Edward M. Kern, photographer and artist.

2. *Steamer John Hancock*, Lieutenant John Rodgers in command; Charles Wright, botanist to expedition, and A. H. Ames, assistant naturalist.

3. *Brig Porpoise*, Alonzo B. Davis, Lieutenant Commanding.

4. *Schooner Fennimore Cooper*, acting Lieutenant Commanding H. R. Stevens.

5. *Store ship John P. Kennedy*, Lieutenant Commanding Napoleon Collins.

These vessels left Norfolk in June, 1853, and went to St. Simon's bay, Cape of Good Hope, and after a short stay, proceeded to Hong Kong, China. The sloop of war Vincennes, Commander C. Ringgold, and the brig Porpoise, Lieutenant Commanding A. B. Davis, by the way of Van Dieman's Land, through the Coral seas, passing the Caroline and Ladrone and Bashee islands, arriving at Hong Kong on the 17th of March; the steamer John Hancock, Lieutenant Commanding John Rodgers, the store ship John P. Kennedy, Lieutenant Command-

ing N. Collins, and the tender Fennimore Cooper, Lieutenant Commanding H. K. Stevens, by the way of the Straits of Sunda and Gasper, the Carimata and Billeton passages, and the Sooloo sea. Their arrival at Hong Kong was reported by Commander Ringgold early in June, 1854.

During the absence of Commodore Perry, with the greater part of the East India squadron, at Japan, the civil war raging in China, and particularly in the vicinity of Canton, so alarmed American citizens holding valuable property in that region, that Commodore Ringgold considered it proper to suspend temporarily the special duties to which he was assigned, and render protection to his exposed countrymen; so that he failed to accomplish a large portion of the surveys that had been planned for the year.

The expedition has, however, again resumed its scientific duties with important results. Several large collections in natural history have been sent home, and others are on the way. Captain Ringgold having returned to the United States, the squadron is in command of Captain Rodgers.

Exploration of the Parana and its tributaries, by the steamer Water Witch.

This surveying steamer, under Lieutenant Commanding Thomas J. Page, left Washington in January, 1853, for the Parana, having as an object the survey of this great river and its principal tributaries. Captain Page was provided with a complete outfit of apparatus for natural history collections, together with a skilful horticulturist, whose business is the gathering of live specimens of the most interesting plants. A good many valuable seeds have already been sent home. The vessel arrived at Buenos Ayres on the 25th of May, but was detained for some time in consequence of the internal dissensions of the country, and the necessity of protecting the interests of American citizens; and it was not until the 7th of November that Captain Page was permitted to leave Ascension to proceed up the river. A small steamer of very light draught, was taken out by the Water Witch, in order to pursue the exploration into waters too shallow for the larger vessel. This vessel has been engaged since her arrival in Paraguay in making the intended explorations, as well as in protecting American interests in that quarter, and the collections made and sent home have added much to our knowledge of the natural history of the country.

Expedition of Lieutenant MacRae, United States Navy.

At the termination of the observations of the United States naval astronomical expedition in Chile, Lieutenant MacRae was instructed by Lieutenant Gilliss to cross the Uspallata pass of the Andes, and the pampas of the Argentine confederation, for the purpose of ascertaining the law of decrease of magnetical intensity with elevation, the atmospheric condition of the higher Andes, the geography of the principally travelled route between Mendoza and Buenos Ayres, and other important facts interesting to men of science. He succeeded in making observations for all the magnetic elements at stations differing in eleva-

tion 3,000 feet, both ascending and descending the Cordilleras, and at each 100 miles in crossing the pampas. Having accidentally broken his barometer and injured his chronometer, shortly after leaving Mendoza, Lieutenant MacRae, as soon as he arrived in the United States, volunteered to return at his own expense for the purpose of completing observations which the loss of these instruments prevented him from doing on his first trip. Permission being granted by the Navy Department, he again embarked for South America, reached Mendoza from Buenos Ayres in time to observe the solar eclipse of November 30, 1853; twice crossed the Portillo pass at an elevation of 14,319 feet; again passed over the Cumbre and Uspallata passes, 12,656 feet; and finally returned to the United States in March, 1854.

Lieutenant MacRae made such collections in natural history as his limited opportunities allowed; among them a new species of the curious genus *Trichomycterus*. He also procured several fine specimens of *Cavia australis*.

The report of his journeys will be found embodied in the first volume of the report of the United States naval astronomical expedition.

Japan Expedition.

Although not specially an exploring party, yet the magnitude of the squadron sent out under charge of Commodore Perry, and the importance of the interests committed to his charge, render a brief notice necessary in this place. The principal object of the expedition was to form a treaty with the emperor of Japan for the protection of American interests in and about the island, as well as to look after these interests generally in that quarter of the globe. The squadron, under command of Commodore Perry, consisted of the steamers Mississippi, Powhatan, and Susquehanna; the sloops of war Macedonia, Plymouth, Saratoga, and Vandalia; and the store ships Supply, Southampton, and Lexingington. With a portion of this fleet Commodore Perry arrived at Jeddo bay on the 8th of July, and, after a brief interview with one of the ministers of state, left, to return in the spring of 1854. Of the happy results of this renewed visit, and of the treaty made with such important bearings on commerce and humanity, I need not here speak, as they are well known to every one. Commodore Perry has returned to the United States, bringing with him copious journals of the voyage, with numerous drawings, and many collections illustrating the natural products and manufactures of Japan. Collections of plants, seeds, reptiles, and fishes, of much interest, were also made by Dr. James Morrow, agriculturist to the expedition.

Brig Dolphin.

Lieutenant O. H. Berryman, in command of the brig Dolphin, has been engaged in a continuation of his previous labors and those of Lieutenant Lee of sounding the depths of the Atlantic Ocean, in connexion with the researches of Lieutenant Maury on the winds and currents of the ocean. His results have been of the highest interest to science, as well as of very great practical value to the navigator. The

report by Lieutenant Lee of his observations while in command of the Dolphin has recently been published by Congress.

Arctic Expedition under Doctor Kane.

The brig Advance which with her consort, the Rescue, had joined in 1850 the band of searchers for the long lost Sir John Franklin, was again fitted out and commissioned for a renewed effort in that direction, under command of Dr. E. K. Kane, the intrepid surgeon and annalist of the first or the Grinnell expedition. The Advance, liberally lent for the purpose by her owner, Mr. Henry Grinnell, was provided with all the means necessary for resisting the vigor of an arctic winter, and for making various deeply interesting observations in natural and physical science in the polar regions. The Smithsonian Institution furnished a complete set of magnetical apparatus, besides fitting out the entire natural history equipment; and the funds necessary for the general expenses were supplied by Mr. Grinnell and by private subscriptions. Doctor Kane intended to have particular attention paid to the Acalephæ and crustacea of the arctic seas, as well as to the collection of skeletons of cetaceans and pinnipedians. Mr. Henry Goodfellow has charge of the natural history department; Dr. I. I. Hayes is surgeon, and Augustus Sontag, astronomer. The entire force consisted of but seventeen men. Dr. Kane proposed to visit Uppernavik, and there procure the necessary dogs and Eskimos for an overland journey, to be fully provided with these as well as with suitable dresses of furs, &c. His intention was to go directly to Smith's Sound at the foot of Baffin's bay, and, passing up the Sound to as great a distance as possible, seek a secure harbor for the winter. He then expected to take his sledge-boats, and with seven men, besides the Eskimos, proceed by land or water, as the case might require, in a direction due north as far as circumstances would allow.

The vessel left New York on the 31st of May, and the latest dates from Dr. Kane were from Uppernavik to July 20, 1853. He had succeeded in obtaining what he needed for his onward march, and expected to start immediately for the north.

Since then nothing has been heard from him, and Congress has authorized an expedition for his succor.

Exploration of the coast of Western Africa, by Lieutenant W. F. Lynch, United States Navy.

Commander W. F. Lynch, United States navy, who left the United States in November, 1852, on a reconnoissance of the coast of western Africa, preparatory to a more extended exploration at some subsequent period, returned on the 1st of May, 1853, having been busily engaged, during the greater part of the interval, in prosecuting the object of his mission. He examined a large portion of the coast of Liberia, and went up a number of the rivers. He suffered much from the sickness which is so constant an attendant of the white man on that coast, and which caused an abrupt termination of his labors. He recommends that any future exploring party should consist almost entirely of citizens of Libe-

ria, organized under the flag of the United States; and that the whites should ride out the fever at Monrovia, on account of the existence of suitable accommodations there. The proper rendezvous for the inland march he considers to be Millsburg, at the head of navigation of the St. Paul's, whence the route should extend *via* Boporah, an important native town, to the range separating the tributaries of the Niger from those which flow into the Atlantic. That range attained, it is to be followed to the parallel of Cape Palmas, and thence to the sea. A full report of the exploration of Commander Lynch is presented in the annual report of the Secretary of the Navy for the first session of the thirty-third Congress.

Darien Ship Canal Expedition.

A survey of the Isthmus of Darien, in reference to the project of uniting the waters of the Atlantic and Pacific by a ship canal, was undertaken under the joint auspices of the English, French, and American governments.

The English expedition sailed for the Isthmus on the 17th of December, 1853, and arrived at Caledonia bay on the 19th of January. It consisted of the brig Espiegle and the survey schooner Scorpion, the former having on board Mr. Gisborne, Dr. Cullen, and Messrs. Forde and Bennett, with four assistant engineers, on the part of the Atlantic and Pacific Junction company, and of Lieutenant Singer, R. E., and staff, in behalf of the British government. The French steamer Chimère joined them, at the same time, with a scientific corps. The United States sloop-of-war Cyane, under Captain Hollins, had reached Caledonia bay on the 8th of January; and, after some preparation, a party under command of Lieutenant Strain, of the United States navy, started out to make the transit. Losing their way, and suffering greatly for want of proper food and water, a number perished, and it was only through the aid of an English party from the Virago that Lieutenant Strain and a few of his men were saved from destruction. The British steamer Virago, Captain Preevorst, attempted the transit from the Pacific side, and reached a point commanding a view of the Atlantic. From the facts gathered by the different parties, it appears conclusively that a canal is impracticable in the region where that survey was made.

Exploration of the Valley of the Amazon.

Messrs. Herndon and Gibbon, of the United States navy, after completing the survey of the valley of the Amazon, returned some time ago, and have published their general report. This contains much that is entertaining and novel, and several large editions have already been called for by Congress.

Exploration by Mr. Scrope.

In December, 1852, Mr. Thomas H. Scrope, an enterprising young gentleman of New York, left Para in a steamer for the town of Loretto,

on the Peruvian Amazon, about 3,000 miles from Para. He took with him everything necessary to make collections in natural history, and has signified his intention of spending as much time as possible in gathering specimens of the animals and plants of that little known region. Nothing has since been heard from him.

Dr. Thomas Steele.

Dr. Thomas Steele, a missionary of the American Colonization Society, left in the packet Shirley, in November, 1853, for Cape Palmas. He intended there to make such collections as were indicated to him as of particular interest, for which purpose a quantity of alcohol was sent out to him by the Smithsonian Institution. Some important collections were sent home by him, and it is with much regret that we are informed of his recent death by fever.

REPORTS OF EXPLORATIONS PUBLISHED IN 1853, 1854.

A—Government Reports.

Captain L. Sitgreaves, U. S. A.—Report of an Expedition down the Zuñi and Colorado rivers, by Captain L. Sitgreaves, United States Topographical Engineers, accompanied by maps, views, sketches, and illustrations. Washington: Robert Armstrong, public printer, 1853. Public document, 32d Congress, 2d session, Senate executive No. 59, one volume 8vo., pp. 198, 78 plates, and one map. An edition was also published by the House.

This report is principally occupied by an account of the natural history of the region traversed by Captain Sitgreaves in this and a previous exploration. The mammals and birds are by Dr. Woodhouse, surgeon and naturalist to the expedition: the reptiles by Dr. Edward Hallowell; the fishes by S. F. Baird and C. Girard; and the plants by Dr. Torrey. Six new species are described of North American mammals, five of birds, eighteen of reptiles, three of fishes, and ten of plants.

Captain R. B. Marcy, U. S. A.—Exploration of the Red river of Louisiana, in the year 1852, by Randolph B. Marcy, captain 5th infantry, United States army, assisted by George B. McClellan, Brevet Captain, United States Engineers, with reports of the natural history of the country, and numerous illustrations. Washington: Robert Armstrong, public printer, 1853, two vols. 8vo., pp. 320, 66 plates and two maps. 32d Congress, 2d session, Senate executive No. 54.

This report includes sub-reports on the minerals, by Professor C. U. Shepard; on the geology of the expedition, by President Hitchcock and George G. Shumard, M. D.; on the palæontology, by B. F. Shumard, M. D.; on the mammals, by Captain Marcy; the reptiles and fishes, by S. F. Baird, and C. Girard; the shells, by Professor C. B. Adams and G. G. Shumard; the orthoptera, arachnida, and myriapoda, by C. Girard; the plants, by Dr. Torrey; and the ethnology by Cap-

tain Marcy and Professor W. W. Turner. Fourteen new species of fossils are described, five of reptiles, five of fishes, ten of orthoptera, arachnida and myriapoda, and three of plants, all of which are figured. Dr. G. G. Shumard acted as surgeon and naturalist, and the collections were made principally by him and Captain McClellan.

Lieutenants Herndon and Gibbon, U. S. N.—Exploration of the valley of the Amazon, made under direction of the Navy Department, by William Lewis Herndon and Lardner Gibbon, lieutenants, United States navy.

Part 1. By Lieutenant Herndon, 2 vols. 8vo. Washington: Robert Armstrong, public printer, 1853, pp. 418, 16 plates and three maps. 32d Congress, 2d session, Senate executive No. 36.

Part 2. By Lieutenant Gibbon, 2 vols. 8vo. Washington: Robert Armstrong, public printer.

Some interesting collections in natural history were made by these gentlemen, but not published in their reports.

Lieutenant S. P. Lee, U. S. N.—Report and charts of the cruise of the United States brig Dolphin, made under direction of the Navy Department, by Lieutenant Lee, 2 vols .8vo. Washington: Beverley Tucker, printer to the Senate, 1854. 15 charts and one map. 33d Congress, 1st session, Senate executive No. 59.

Captain W. F. Lynch, U. S. N.—Official report of a mission to Africa in 1852, 1853; pp. 329—366 of the report of the Secretary of the Navy, in President's message for 33d Congress, 1st session. Part III, 1853.

Professor A. D. Bache.—Report of the Superintendent of the Coast Survey, showing the progress of the survey during the year 1852. One vol., 4to. Washington: Robert Armstrong, public printer, 1853. Pp. 184 and 37 plates.

Professor A. D. Bache.—Report of the Superintendent of the Coast Survey, showing the progress of the survey during the year 1853. One vol., 4to. Washington: Robert Armstrong, public printer. Pp. 278, and 54 plates.

H. R. Schoolcraft, LL. D.—Information respecting the History, Condition and Prospects of the Indian tribes of the United States; collected and prepared under the direction of the Bureau of Indian Affairs per act of Congress of March 3, 1847, by Henry R. Schoolcraft. Illustrated by S. Eastman, Capt. U. S. A. Published by authority of Congress ———. Part III, 4to., 1853, pp. 636 and 45 plates. Part IV, 4to., 1854, pp. 668 and 41 plates.

These volumes, in addition to the subjects specially covered by the title, contain valuable journals of expeditions by officers of the United States army and others, at various periods of time.

Pacific Railroad Surveys.—Letter from the Secretary of War transmitting reports of surveys, &c., of railroad routes to the Pacific ocean, made February 6, 1854. 8vo., pp. 118. 33d Congress, 1st session, Ex. doc. No. 46.

This contains the partial reports from the several expeditions, all of them still in the field at the date of the report.

Report upon the northern Pacific railroad exploration and survey, by Gov. I. I. Stevens, made June 30, 1854. Pp. 548.

Report of explorations for a railway route near the 35th parallel of

latitude from the Mississippi river to the Pacific ocean, by Lieut. A.W. Whipple, corps of topographical engineers, made July 31, 1854. 8vo., pp. 154.

Report of Explorations for that portion of a Railway Route near the 32d parallel of latitude, lying between Doña Ana on the Rio Grande, and the Pima village on the Gila, by Lieut. Jno. G. Parke, U. S. A., of corps topographical engineers. Made August 22, 1854. 8vo., pp. 32.

The above are all the railroad reports published in 1854, the remainder not being finished till 1855. The maps accompanying the reports were not finished in 1854.

B—Private reports.

Dr. E. K. Kane, U. S. N.—The United States Grinnell Expedition in search of Sir John Franklin. A personal narrative. By Elisha Kent Kane, M. D., U. S. N. New York: Harper and Bros. 1 vol., 8vo. 1853.

John R. Bartlett.—Personal narrative of Explorations and Incidents in Texas, New Mexico, California, Sonora, and Chihuahua, connected with the United States and Mexican Boundary Commission in 1850–'53. By John Russell Bartlett, United States Commissioner during that period; with maps and illustrations. 2 vols., 8vo., 1854. New York: D. Appleton & Co.

G. H. Heap.—Central route to the Pacific, from the valley of the Mississippi to California. Journal of the expedition of E. F. Beale, Superintendent of Indian Affairs in California, and Gwinn Harris Heap, from Missouri to California, in 1853. By Gwinn Harris Heap. Philadelphia: Lippincott, Grambo, & Co. 1 vol., 8vo. 1854. With map and illustrations.

Lieut. J. G. Strain, U. S. N.—Report of the Darien expedition. Harper's Magazine for March, April, and May, 1855.

REPORTS ORDERED BY CONGRESS, AND TO BE PUBLISHED.

Lieut. J. M. Gilliss, U. S. N.—Report of the United States naval astronomical expedition in Chile. This report will occupy several volumes quarto, and contain much matter on the natural history of the country.

Commodore M. C. Perry, U. S. N.—Report of the Japan expedition.

Captain C. Ringgold, U. S. N.—Report of the Expedition for the exploration of the China seas and Behring's straits.

Reports of the several parties for survey of railroad routes from the Mississippi river to the Pacific ocean. These will embrace the government expeditions under Gov. I. I. Stevens, Lieut. A. W. Whipple, Lieut. E. G. Beckwith, Lieut. R. S. Williamson, Lieut. J. G. Parke and Capt. J. Pope, with the private ones of Col. J. C. Frémont and Mr. Lander.

A. B. Gray.—Report and map of surveys in New Mexico, &c.

Professor A. D. Bache.—Report of the superintendent of the United States Coast Survey during the year 1854.

H. R. Schoolcraft, LL. D.—History and Statistics of the Indian

tribes of the United States. Parts V and VI. The sixth and last part is to contain an abstract or synopsis of the whole work.

CONCLUDING REMARKS.

The record of explorations for the year will be incomplete without brief reference to the numerous researches and collections made at different points in North America, the results of which have come to the knowledge of the Institution. Few have any conception of the amount of quiet investigation in natural history now going on in this country, principally by persons laboriously engaged in other duties and using only scattered intervals of leisure. The records of the Institution almost daily receive entries of contributions of facts and specimens of natural history from such sources.

Some general remarks and notices on this subject will be found detailed in the report on additions to the museum in 1854. I would, however, make a particular reference to the labors of Lieutenant W. P. Trowbridge, United States army, who, while successfully prosecuting his duty as tidal observer on the Pacific coast, in connexion with the United States Coast Survey, has employed his leisure moments in forming one of the largest collections of natural history ever made in this country. In this he has been zealously aided by Messrs. Cassidy, Szabo, and others, members of his parties.

Mr. R. D. Cutts, likewise connected with the Coast Survey, has also made some interesting collections on the coast of California and transmitted them to the Institution; and a gentleman of the same branch of the public service, Mr. Gustavus Wurdemann, has supplied one of the fullest series of the animals of the Louisiana gulf coast ever received by the Institution. It is a subject of profound congratulation that while exhausting every department of physical research in connexion with the survey of our coast, the distinguished superintendent encourages his assistants to pay all possible attention to the various branches of natural science, recognising fully their connexion with those more immediately belonging to the survey. One effect has been the gathering together of vast materials illustrating the marine infusoria and microscopic shells of our coast, which have already been examined with important hydrographical results.

LECTURES

DELIVERED BEFORE THE SMITHSONIAN INSTITUTION.

No. I.—THE CAMEL.

BY HON. GEO. P. MARSH.

The first command addressed to man by his Creator, and substantially repeated to the second great progenitor of our race, not only charged him to subdue the earth, but gave him dominion over all terrestrial creatures, whether animate or inanimate, and thus predicted and prescribed the subjugation of the entire organic and inorganic world to human control and human use.

Man is yet far from having achieved the fulfilment of this grand mission. He has, indeed, surveyed the greater part of his vast domain; marked the outline of its solid and its fluid surface, and approximately measured their areas and determined their relative elevation; pierced its superficial strata, and detected the order of their historical succession; reduced to their primal elements its rocks, its soils, its waters, and its atmosphere, and even soared above its canopy of cloud. He has traced, through the void of space, its movements of rotation, revolution, and translation; resolved the seeming circles of its attendant satellite into strangely tortuous paths of progression; investigated its relations of density, attraction, and motion, to other visible and invisible cosmical orbs; and unfolded the laws of those mysterious allied agencies, heat, light, electricity, and magnetism, whose sphere of influence seems commensurate with that of creation. But, notwithstanding these triumphs, earth is not yet all his own; and millions of leagues of her surface still lie uninhabited, unenjoyed, and unsubdued—yielding neither food, nor clothing, nor shelter to man, or even to the humbler tribes of animal or vegetable life, which, in other ways, minister to his necessities or his convenience.

In like manner, man has studied the biography, and the relations of affinity or dependence, of the infinitely varied contemporaneous forms of organic life; traced the history of myriads of species of both plants and animals, which had ceased to be before the Creator breathed into *his* nostrils the breath of life; and demonstrated the past and present existence of numerous tribes of organic beings, too minute to be individually cognizable by any of the unaided senses, and yet largely influencing our own animal economy, and even composing no unimportant part of the crust of the solid globe; but of the vegetables that clothe and diversify its soil, of the animated creatures that float in its atmosphere, enliven its surface, or cleave its waters, but comparatively few have as yet been rendered in any way subservient to human use, fewer

still domesticated and made the permanent and regular denizens of his fields or companions of his household.

The efforts of civilized man towards the fulfilment of this great command have been directed almost exclusively to the conquest of inorganic nature, by the utilization of minerals; by contriving methods for availing himself of the mechanical powers and of natural forces, simply or in cunning combinations; by cutting narrow paths for facilitating travel and transport between distant regions; and by devising means of traversing with certainty and speed the trackless and troubled ocean.

The proper savage smelts no ores, and employs those metals only which natural processes have reduced. He binds the blocks of which he rears his temples with no cement of artificial stone. He drains no swamps, cuts no roads, excavates no canals, turns no mills by power of water or of wind, and asks from inorganic nature no other gifts than those which she spontaneously offers, to supply his wants and multiply his enjoyments.

On the other hand, the very dawn of social life, in those stages of human existence which quite precede all true civilization, demands, as an indispensable condition, not the mere usufruct of the spontaneous productions of organic nature, but the complete appropriation and domestication of many species of both plants and animals. Man begins by subjugating, and thereby preserving, those organic forms which are at once best suited to satisfy his natural wants, and, like himself, least fitted for a self-sustaining, independent existence;* and he is to end by extending his conquests over the more widely dissimilar, remote, and refractory products of creative nature. We accordingly owe to our primeval, untutored ancestors, the discovery, the domestication, the acclimation of our cereal grains, our edible roots, our improved fruits, as well as the subjugation of our domestic animals; while civilized man has scarcely reclaimed a plant of spontaneous growth, or added a newly tamed animal to the flocks and herds of the pastoral ages. Indeed, so remote is the period to which these noble triumphs of intelligent humanity over brute and vegetable nature belong, that we know not their history or their epochs; and if we believe them to be in fact human conquests, and not rather special birth-day gifts from the hand of the Creator, we must admit that cultivation and domestication have so completely metamorphosed and diversified the forms and products, and modified the habits, and even, so to speak, the inborn instincts of both vegetables and animals, that but the fewest of our household beasts and our familiar plants can be certainly identified with the primitive stock. Most of these, it is probable, no longer occur in their wild state and original form; and it is questionable whether they are even capable of continued existence without the fostering care of man.

In both these great divisions of organic life there are some species

* It is not the domestic animals alone whose existence is perpetuated by the protective, though often unconscious, agency of man. In the depths of our northern forests the voice of the song-bird, or of the smaller quadrupeds, is but seldom heard. It is in the fields tilled by human husbandry that they find the most abundant nutriment, and the surest retreat from bird and beast of prey. The vast flights of the wild pigeon are found, not in the remote, primitive woodlands, but along the borders of the pioneer settlements; and, upon our western frontier, it is observed that the deer often multiply for a time after the coming in of the whites, because the civilized huntsman destroys or scares away the wolf, the great natural enemy of the weaker quadrupeds.

peculiarly suited to the uses of man as a migratory animal. The bread stuffs of the old world, and, in a less degree, our only American cereal, Indian corn, the pulse, the cucurbitaceous plants, and the edible roots of our gardens, as well as the horse, the dog, the sheep, and the swine, seem almost exempted from subjection to climatic laws. While, therefore, a degree of latitude, a few hundred feet of elevation, a trifling difference in soil, or in the amount of atmospheric humidity, oppose impassable barriers to the diffusion of most wild plants and animals, the domesticated species I have enumerated follow man in his widest wanderings, and make his resting-place their home, whether he dwells on a continent or an island, at the level of the sea or on the margin of Alpine snows, beneath the equator or among the frosts of the polar circle.

Others, again, of the domesticated families of the organic world seem, like the untamed tribes, inexorably confined within prescribed geographical bounds, and incapable of propagation or growth beyond their original limits; while others still, though comparatively independent of climate and of soil, are nevertheless so specially fitted to certain conditions of surface, and certain modes of human life, to the maintenance of which they are themselves indispensable, that even the infidel finds, in these mutual adaptations, proofs of the existence and beneficent agency of a self-conscious and intelligent creative power.

Among the animated organisms of this latter class, the camel is, doubtless, the most important and remarkable. The Ship of the Desert has navigated the pathless sand-oceans of Gobi and the Sahara, and thus not only extended the humanizing influences of commerce and civilization alike over the naked and barbarous African and the fur-clad Siberian savage, but, by discovering the hidden wells of the waste and the islands of verdure that surround them, has made permanently habitable vast regions not otherwise penetrable by man. The "howling wilderness" now harbors and nourishes numerous tribes in more or less advanced stages of culture; and the services of that quadruped, on which Rebekah journeyed to meet her spouse, and which, though neglected and despised by the polished Egyptian, constituted a principal item in the rural wealth of the father of Joseph, are as indispensable to these races, as are those of any other animal to man in any condition of society.

The camel lives and thrives in the tropics; through almost the whole breadth of the northern temperate zone; and is even met beyond Lake Baikal in conjunction with the reindeer, with which, among some of the northern tribes, he has exchanged offices, the deer serving as a beast of the saddle, while the camel is employed only for draught or burden.* But his appropriate home is the desert, and it is here alone that he acquires his true significance and value, his remarkable powers being the necessary condition and sole means by which man has in any degree extended his dominion over the Libyan and the Arabian wildernesses.

In presence of the improvements of more advanced stages of society, the camel diminishes in numbers and finally gives place to other animals better suited to the wants and the caprices of higher civilization. Upon good roads, other beasts of draught and burden are upon the whole more serviceable, or, to speak more accurately, more acceptable to the

* Ritter, Erdkunde XIII, 662—667.

tastes of cultivated nations; and the ungainly camel shares in the contempt with which the humble ass, the mule, and even the ox, are regarded by the polished and the proud. Besides this, both the products and the restraints of proper agriculture are unfavorable to his full development and physical perfection. When the soil is enclosed and subjugated, and the coarse herbage and shrubbery of spontaneous growth are superseded by artificial vegetation, he misses the pungent and aromatic juices which flavor the sun-burnt grasses and wild arborescent plants that form his accustomed and appropriate diet; the confinement of fence, and hedge, and stall are repugnant to his roving propensities and prejudical to his health, and he is as much out of place in civilized life as the Bedouin or the Tartar. Hence the attempts to introduce him into Spain, Italy, and other European countries have either wholly failed, or met with very indifferent success; and though he still abounds in Bessarabia, the Crimea, and all the southeastern provinces of Russia, yet the rural improvements which the German colonists have introduced into those regions have tended to reduce his numbers. When the wandering Tartar becomes stationary, encloses his possessions, and converts the desert steppe into arable ground, his camels retreat before the horse, the ox, and the sheep, and retire to the wastes beyond the Don and the Volga. So essentially nomade indeed is the camel in his habits, that the Arab himself dismisses him as soon as he acquires a fixed habitation. The oases of the desert are generally without this animal, and he is not possessed by the Fellahheen of the Sinaitic peninsula, by the inhabitants of Sinah or the oasis of Jupiter Ammon, or by those who cultivate the valleys of Mount Seir.

Of the primitive races of man, known to ancient sacred and profane history, but one, the Bedouin Arab, has retained unchanged his original mode of life. It is the camel alone, whose remarkable properties, by making habitable by man regions inaccessible to the improvements of civilization, has preserved to our own times that second act of the great drama of social life, the patriarchal condition. The Arab in all his changes of faith, heathen, christian, mussulman, has remained himself immutable; and the student of biblical antiquity must thank the camel for the lively illustrations of scripture history presented by the camp of the Ishmaelite sheikh, who is proud of his kindred with the patient Job, and who boasts himself the lineal descendant of Ibrahim el Khaleel, or Abraham "the friend" of God.

Naturalists divide the camel into two species, the *Camelus dromedarius*, or one-humped camel of Arabia and Africa, and the *Camelus Bactrianus*, or two-humped camel of northern Asia.* It has been suspected that the camel of the Sahara is distinct from that of more northern Africa,

* These geographical limitations, if not strictly accurate are nevertheless sufficiently so for general purposes. Although Höst (Efterrettninger om Marokos, 270) saw the two-humped camel at Morocco, and individuals of this species are sometimes met in Syria, yet it is pretty certain that he is not bred in Africa, or in the warmer regions of the Asiatic continent, but properly belongs to northern latitudes. The one-humped camel has a wider range. He is found among the Kirghises, and in Tartary, and the highlands of central Asia; he seems to bear the cold almost as well as the Bactrian, but he has neither the speed nor the powers of endurance which characterize the dromedary of the African and Arabian deserts. Although neither species probably now exists in a wild state, yet there is good reason to believe that the Bactrian was found wild at no very remote period in the desert of Gobi, where this variety probably originated. Humboldt, Ansichten der Natur, I, 88.

which is pretty certainly of the Arabian stock, and of comparatively late introduction into that continent;* but this conjecture does not appear to be supported by any direct historical or physiological evidence. The scientific specific designation of the one-humped camel is not well chosen. The term *dromas*, as applied to the camel by the ancients, was not used to indicate a *specific* difference. The *camelus dromas* was what the proper *dromedary* is now, that is, simply a *running*, or swift camel, used chiefly or altogether for the saddle; and he might be, as he may be still, of either species, Bactrian or Arabian. In fact, any light-built, easy-paced, and swift-footed camel, of whatever species or variety, is a dromedary; though there are certain breeds, in which the slender head, tall short body, small hump, clean limbs, and generally livelier color, which characterizes the stock, have become hereditary, just as similar peculiarities of form are perpetuated in the thorough-bred hunter and race-horse. In popular phraseology, the term dromedary has been to a considerable extent applied to designate a camel with two humps, from an erroneous supposition that the swift riding-camel (deloul al heiri or maherry of the Arabs, haguin or hedjin of the Egyptians) was of that species. This mistake appears to have originated in a misinterpretation of a passage of Aristotle by Solinus and Theodore Gaza; and the error, though exposed and corrected by Gesner, three hundred years ago, and by almost every naturalist who has since described the animal, continues to influence the language, and mislead the popular opinion of the nineteenth century.

The varieties comprehended under each of the two species are numerous; but they do not differ from each other in size, in form, or in speed, more widely than the breeds of the common horse. Indeed the anatomical differences between the Arabian and the Bactrian camel are so slight, that some naturalists have maintained their specific identity; and it appears to be certain that the common physiological test of specific difference, the incapacity, namely, of the cross to propagate, does not hold good as applied to this animal.† The skeletons of the two species are distinguishable, if at all, only by a slight difference of proportion; and the visceral structure being the same in both, the only foundation for a specific distinction appears to be in the number of humps. In the living animal, the species are readily distinguished by their outward peculiarity; and besides their obvious difference, the Bactrian is shorter limbed and much more hairy than the Arabian camel.

*Minutoli thinks he recognises the head of the camel among the figures upon an obelisk at Luxor. Upon the walls of some of the smaller apartments of the great temple of Karnac are carved heads, which certainly appear to me to resemble that of this animal more closely than of any other quadruped; and St John (Adventures in the Libyan Desert, Chap. XII) says he found the camel among the sculptures of the temple at the oasis of Jupiter Ammon. But modern Egyptologists consider some of these figures to represent the head of the lion, others that of the giraffe, and it is certain that no part of the skeleton of the camel has been met with in the catacombs. Although it appears from Strabo, that the tribes of the desert anciently employed the camel in the transport of merchandise between Captos and Berenice, as they do now between Cairo and Suez, yet there is abundant evidence to show that this animal was not used by the proper Egyptians before the time of the Ptolemies, nor does it appear to have been known upon the Barbary coast until a much later period. See Ritter's essay, Ueber die geographische Verbreitung des Kameels, Erdkunde XIII, where this question, and almost all others belonging to the geographical distribution of the camel, are discussed with the usual learning and ability of that great writer.

† Ritter, Erdkunde XIII, 659.

Some writers describe the Bactrian as upon the whole smaller and weaker than the Arabian; but as others state the contrary, the difference in this respect is probably not great. It seems well settled that in countries where the two species exist together, the cross, though inferior to the dromedary in speed, is found to be a more powerful, and for general purposes a more serviceable animal than either of the unmixed races, as possessing in a good degree the most valuable properties of both.*

The general anatomy of the camel is the same as that of other ruminants; but the hump, the horizontal posture of the head, the direction of the eye, the power of closing the nostril, the callosities upon the breast and legs, the spreading and cushioned foot, and above all the curious structure of the stomach, to which he owes his most valuable property, the power of long abstinence from water, distinguish him from all other quadrupeds. The hump is simply a fleshy, or rather fatty, protuberance upon the back, like that of the bison, unsupported by any special bony process, and it is least developed in the highest bred animals, so that the maherry of the Sahara is popularly described as being without that appendage. The fullness of the protuberance, however, depends much upon the condition of the animal. The state of the hump is a test constantly referred to in the sale or hire of the camel, and the jockeys resort to various contrivances to give it an unnatural plumpness and solidity.† When the camel has been, for a length of time, full fed, and subjected to moderate labor only, the hump assumes a greater plumpness of form and hardness of texture; but if ill kept or overworked, the fat of the hump is absorbed, and the protuberance becomes flaccid, and is sometimes even reduced to little more than its skin. It seems to serve as a repository of nutriment, and the absorption of its substance into the general system appears to be one of the special arrangements by which the camel is so admirably fitted for the life of privation to which he is destined.‡

The head of the camel, especially of those of the Bisharye and Ababdeh breeds, is carried high and nearly horizontal; and this circumstance, with the length and curvature of the neck, and the outline of the arched back, creates so strong a general resemblance between this quadruped and the ostrich, that the latter is called by the Arabs the camel-bird. The eye is projecting, sheltered above by a very salient bony arch, and its axis is nearly parallel to that of the head, though with a slight inclination towards it anteriorly. From this conformation of the organ, the sight of the animal is habitually directed rather downwards than forward, to the ground upon which he is just about to tread than to the distance. It is, in a great degree, to this structure, as I believe, that his remarkable sure-footedness is to be attributed. The eye always scans the surface where the foot is next to be placed; and in moving about among the scattered luggage and

* See a valuable paper, extracted from the notes of General Harlan, in the Report of the American Patent Office for 1853, Agriculture, p. 61. According to Ritter, Erdkunde XIII, 646, and the authorities there cited, the word Booghdee, used by General Harlan to designate the cross between the Bactrian and Arabian, means the young male Bactrian. General Harlan's testimony in favor of the strength and power of endurance of the mixed breed is exceedingly strong; but he appears to undervalue the pure Bactrian, which is certainly found extremely serviceable in European and Asiatic Russia, both for draught and burden, and in those countries, at least, is almost wholly exempt from disease. Fraser, Khorasan, 273.

† Tavernier: Voyages, I. 132. ‡ Carbuccia, 10.

furniture of a camp, he rarely treads on the smallest article. The nostrils are fringed with long hairs, and provided with sphincters, which enable the animal to close them, and thus to exclude insects and the sand with which the desert winds are so often charged, while the hairs, to a considerable extent, perform the same office during the occasional partial opening of the apertures, required for respiration. The Bedouins understand the value of a wide nostril as well as a Newmarket jockey, and they frequently slit the nose of the animal in such a way as to give each aperture the form of a Y. The slitting of the nostrils is a common preparation for a race, and I once saw this absurd operation performed upon a dozen young dromedaries, which were to contend for the prize on the following day.

The camel is provided with seven callosities, which receive the shock of his fall in lying down for repose, or at the command of his master for the convenience of mounting or dismounting, or of loading and unloading, and the weight of the body is supported by them when at rest. One of these is upon the breast nearly between the fore legs, two upon each of the fore, and one upon each of the hinder legs. The callosities upon the breast and at the knees are evidently organic, as they consist of a horny substance and are found in the fœtus. The others appear to be a mere thickening of the skin, and they may be the effect of friction and pressure. The full development of the callosities is one of the "points" of a good maherry, and it ought to be accompanied with a slender barrel, so that in the recumbent posture the belly shall scarcely touch the ground.

In lying down the animal throws himself slightly forward, and first bending one fore leg, poises himself for an instant, and then falls suddenly upon the callosities at the knees; he now advances the hind feet a little and drops upon the gambrel joint; the callus upon the breast is brought to the ground by a third descent, and those upon the upper and forward part of the hind leg by a fourth. Each of these movements, (which are renewed in rising,) and especially the first, is attended with a considerable shock; and the inexperienced rider is very apt to be thrown over the camel's head, unless he steadies himself by holding fast to the saddle pins. The Arabs slide down from and climb up to the saddle, without making the animal kneel, or even stopping him, and any active man may readily learn to do the same, but Europeans seldom practice this method. The French soldiers in Algeria use a long stirrup with two *steps* to mount by, and a loop upon a lance, such as were used by some ancient mounted troops, or attached to a musket, might answer the same purpose.

The foot of the camel is equally adapted to treading upon yielding sand and to climbing the rugged rock, which, in all extensive deserts, forms a much larger proportion of the surface than accumulations of sand. The surface of the wilderness is in general a hard, compact, gravelly soil, or composed of loose stones or bare rocks, and wherever it is not too hard for wear, or too soft permanently to retain impressions, the valleys pursued by the caravans are furrowed with paths which have been thousands of years in wearing. These tracks are 15 or 18 miles wide, and four or five inches deep, running generally parallel to each other at a couple of yards apart, and now and then inter-

tersecting each other. An Arabian poem, older than the time of Mohammed, compares these paths to the stripes of a parti-colored cloak; and the Arabian traveller of the present day finds the same resemblance between the face of the desert and the "many colored coat" of its more opulent inhabitants.

The foot is composed of two long toes united by and resting upon an elastic cushion with a tough and horny sole or facing. The foot spreads upon touching the ground, somewhat like that of the moose and reindeer, and affords a broader support to the weight of the animal than almost any other quadruped is provided with. The camel, therefore, sinks less in the sand than any other large animal; but he nevertheless instinctively avoids it, as a horse does a puddle, and prefers any other surface except mud, loose rolling pebbles, and sharp pointed rocks.* The sole, though of a horny texture, is sufficiently yielding to allow the cushion of the foot to accommodate itself to the inequalities of a rocky surface,† and the camel climbs with facility ascents so steep and rugged, or even so slippery, as to be scaled with difficulty by any other domestic animal. The limestone ledges in the northern portion of the lesser Arabian peninsula are often worn to a glassy smoothness by primitive water currents, or by the attrition of the desert sands, yet the camel traverses them in all directions with entire security. Observing a caravan climb a long ascent of this description in Arabia Petrea, I had the curiosity to measure the inclination of the rock, and found the angle with the horizon to be fifteen degrees. The surface was everywhere almost as slippery as polished marble, and the length of the slope exceeded half a mile; but the whole caravan of more than fifty camels surmounted it without any accident. The northern slope of the pass of Negabad, on the eastern arm of the Red sea, appears to me even steeper than that I have just described, and the path is as rugged and the zigzags as short as those of almost any of the mule routes over the Alps, but it is constantly crossed by loaded caravans without difficulty. But these are trifles compared with the performances of camels in Algeria, as stated by the French officers. According to an official report to the war department of France in 1844, in the expedition to Milianeh, camels carrying burdens of 250 kilogrammes (550 pounds) climbed without accident slopes rising at an angle of 45 degrees, and readily traversed every route practicable by mules.‡

This structure of the foot gives the animal a peculiarly noiseless tread. The thunder which at a distance announces the approach of a troop of cavalry, does not herald the advance of a caravan; and even his rider hears but the faint rustling of the sand or the small pebbles displaced by the foot, as they roll back to the cavity left by the tracks of the animal. The regularity of his step and their gentle, purling sound, excite a peculiarly drowsy influence in the silence of the

* Denham and Clapperton's Travels, I, chap. 3, do. p. 169. Pietro della Valle complains that his camel, though the freshest and strongest in the caravan, fell in the soft sand "more than seven times in one day."

† The sole seems entirely impenetrable to thorns, and the camel treads with impunity on the strong sharp spines with which the fallen branches of the desert acacias are thickly armed.

‡ Carbuccia: Du Dromadaire, pp. 8, 169.

wilderness, which not even the danger of a fall enables the inexperienced traveller always to resist.

In mud the footing of the camel is insecure. The hind legs are little separated down to the gambrel joint, but from this point they diverge at a considerable angle, so that the ancient poem I have before quoted compares the hinder feet to two water buckets borne upon a yoke, and the increased breadth of base thus acquired contributes much to the sure-footedness of the camel on dry ground.

Upon a wet and slippery soil, on the contrary, the liability of the foot to slide is increased by this arrangement; and in case of such an accident, as the foot usually slides laterally, the hip joint is often dislocated or so badly wrenched that the animal is unable to rise with his burden and proceed upon his journey.* It is commonly said that the camel never rises after falling under his load, and that he immediately perishes under such circumstances. I have myself witnessed instances to the contrary, although I have no doubt that where the fall is from exhaustion the death of the animal is nearly certain. Where the mud is merely a thin layer of wet earth over a rocky or other very hard surface, the camel passes over it without much risk; and I have repeatedly seen caravans travel at their ordinary pace and with entire confidence and security over pavements covered with several inches of snow and soft mud.

The camel readily fords rivers with gravelly or pebbly bottoms, and I have seen them wade around headlands in the Red sea, in water three or four feet deep; but the passage of streams with soft bottoms, or with deep water, by camels is always a matter of great difficulty. It is almost impossible to train them to enter a ferry boat, or to lie quietly in crossing rivers by this mode of conveyance; and though they float readily, yet they are bad swimmers, the roundness of the barrel and the height of the head and hump above the line of flotation exposing them constantly to the danger of losing their balance and rolling over upon the side, in which case they are sure to be lost. For this reason it is common to lash the head to the gunwale of a boat, or to support it by some other contrivance in crossing deep waters.†

But the most interesting and important anatomical peculiarity of the camel is that curious structure by which he is enabled to take in at once and retain, by a special arrangement, a sufficient quantity of water to supply the wants of the animal economy for several days. It was conjectured by Cuvier, and it is believed by some more recent naturalists, that the stomach of the camel is not only able to retain for many days water swallowed by the animal, but that it possesses the further power of secreting a special fluid for moistening the fauces and viscera, and mingling with the food in rumination, in some such way as some fish are able to keep the skin moist for some time after they are taken from the water, by the exudation of a fluid secreted for that purpose. It is even said that the fluid found in the water-sack, after the death of the camel, possesses chemical properties which prove it to be an

* According to General Harlan, (Patent Office Report, 1853,) the hind legs are sometimes hobbled above the gambrel joint to prevent their spreading.

† Denham and Clapperton, II, pp. 80, 212. Father Huc, I, chap. 6. Lyon's Travels, p. 124.

animal secretion; but it does not appear that this fact has been established to the satisfaction of the physiological chemist.*

It is not easy to explain the structure of the stomach without drawings, and it must suffice to say that, according to Sir Everard Home, it consists, like that of other ruminants, of four cavities. The first of these performs the functions of both the first and second in the horned ruminants; the second is simply a receptacle for water; the use of the third is not ascertained; and the office of the fourth is the same as that of the corresponding stomach in other animals having four gastric cavities.†

Thus by means of the nutriment supplied by the absorption of the hump, and the fluid preserved in, and, perhaps, also secreted by, the water-sack, the camel is able to travel several days without any new supplies of food or water. The period of abstinence depends upon the breed, training, and habits of the particular animal, the season and temperature, and the amount of labor demanded of him.

With respect to food, there is no doubt that the camel often endures two, three,‡ and even more days of entire privation; but long abstinence is seldom necessary, because, although there is one well attested instance of the existence of a tract of desert frequently crossed by caravans, six days' journey in width, and absolutely without a particle of vegetation,§ yet there are few portions of the Libyan or Arabian deserts where more or less of the shrubs on which the camel feeds do not occur at very much shorter intervals.

According to Denham, the African camel is prepared for long journeys by having balls of dough crammed down his throat, while, on the contrary, Father Huc, a much less reliable authority, declares that the Bactrian is hardened by several days of previous abstinence. Under ordinary circumstances, the camel is not fed at all, even on very long journeys, but is left to snatch his food as he can during the march of the caravan, or gather it more leisurely while it halts. In a journey of seven weeks which I made with these animals in Arabia Petræ in the months of May and June, but a single camel of the caravan received any food from his driver. This was a fine large animal bred by the Ababdeh Arabs, which was fed every evening with from a pint to a quart of beans.

When herbage and browse are altogether wanting, a small quantity of beans, a few handfulls of dates or even date-stones, a ball or two of dough of barley-meal, millet, or other grain, weighing from one to three pounds, or a small supply of some dry vegetable are given each camel daily. According to Edrisi, they are sometimes fed with dried fish. Denham says they are fond of bones, and Riley even declares that he sometimes saw them fed with charcoal. The favorite food of the camel consists of the leaves, branches, and seed-pods of the acacias and other prickly trees or shrubs, of thistles, and of the saline plants so common

* According to Carbuccia, the fluid in the water-sack remains undamaged and drinkable several days after the death of the camel.—Du Dromadaire, 12.

† The gall bladder is wanting in the camel, and no trace of the biliary secretion has been found upon dissection.—Plinii Hist. Nat. XI, 74; Carbuccia, 103.

‡ Carbuccia, 10.

§ Denham and Clapperton, I, c. 3.

in the desert; and every vegetable zone is found to furnish some plant specially suited to his nutriment, while, in case of necessity, he scarcely refuses any green thing.* His powerful jaws and teeth enable him to grind and masticate branches of the hardest wood as thick as the finger. His palate is lined with a very hard cartilage; and the inside of the lip, the tongue, and the gums are protected by a skin almost equally impenetrable. The lips are, nevertheless, very flexible, and the upper labrum is divided. In feeding on the acacia or other prickly plants, he retracts and partially inverts the lips, grasps the twigs with the tongue and jaws, and thus crops and chews the thorniest shrubs with impunity.

The camels domesticated in Tuscany, which, though degenerated by a residence of centuries in the moist climate and alluvial soil of the lower Arno, are of the Arabian stock, neglect the green and tender cultivated grasses, but devour with avidity the leaves and smaller branches of the oak and the alder, and the hard dry stems of the thorn, the thistle, and the broom. The working camels at the grand duke's farm, near Pisa, are sheltered and fed on hay during the winter, but the rest of the herd remain in the open air, and subsist on twigs and withered shrubs through the cold season.

The Bactrian camel has the same fondness for saline plants as his African congener; but he feeds also upon the leaves, twigs, and bark of deciduous trees, the coarsest grasses, thistles, reeds, rushes, weeds, straw, and, in short, upon such vegetable diet as is rejected by almost every other domestic quadruped.

The statements of travellers differ very considerably in regard to the quantity of solid food required by the camel. My own observation would lead me to think it extremely small. As I have already stated, he is usually not fed at all; and in travelling his only opportunity of gathering his food is between the evening halt and sunset, when he returns to the camp, with such scattering mouthfuls as he can snatch upon the march. The vegetation of the desert is usually so sparse that the quantity of nutritious food which can be collected after the day's journey is performed must be very inconsiderable; and though upon starting in the morning the animal shows signs of hunger, and much annoys his rider by suddenly stopping or starting aside to crop a tempting thorn twig or thistle, yet in an hour or two his appetite is satisfied, and he performs the rest of his task without seeming to crave food. I was assured by the keeper of the herd at Pisa, that when fed entirely on hay, the camel consumed little more than half as much as the horse; while, on the other hand, a correspondent in the Crimea informs me that the Bactrian camel requires at least fifty pounds of hay per day in winter, and another in Bessarabia estimates the daily winter supply of hay and straw at seventy pounds. Pattenger states that the camels in Beloochistan receive about fifteen pounds of meal daily, besides grass and shrubs, and he adds the singular fact that the Beloochees give these animals considerable quantities of opium with their food; but most travellers state that when fed at all, the camel receives five

* Carbuccia, page 10, says that the camel never touches the "aloe;" but an official report, at page 182 of the same volume, enumerates the "cactus" among the wild vegetables consumed by him.

or six pounds of meal at most. The power of the camel to abstain from water is much more frequently and severely tested than his ability to dispense with food. The testimony of travellers, as well as of native observers on this subject varies widely; but their discrepancies can generally be explained by difference of breed, of season, or the greater or less succulence of the solid food consumed by the animal.

The most extraordinary statements I have seen are those of the official reports of the French officers attached to the dromedary corps in Algeria. One of these reports declares that the camels of the corps employed in the expedition of El Aghouat did not drink from February to May, though the weather was very hot; and General Carbuccia, the commander of the corps, positively states that the Algerine camel under no circumstances drinks oftener than once in seven days.* Although many travellers have related cases of very long privation, while the animal had daily access to an abundant supply of green succulent food, yet that excellent observer Russell mentions an instance of fifteen days abstinence as altogether unprecedented; and I have been able to find but one other well authenticated case, which is that mentioned by Denham and Clapperton,† of so long an abstinence as eight days, when the animal fed mostly on dry food. Most travellers concur in saying that under such circumstances the extreme limit of endurance of the Arabian camel, whose powers in that respect are much greater than those of the Bactrian or other northern breeds, does not exceed five or six days. The longest period of complete privation I have personally witnessed was four days in very hot weather, and upon withered fodder; and I have always observed that the camel drank as often as he had an opportunity. In most countries where the animal is used, it is said he can dispense with drinking twice as long as the horse under the same circumstances. This I doubt not is a very near general approximation to the truth.‡ These facts, however wonderful, are by no means so extraordinary or incredible as they may at first sight appear. The domestic ox, when supplied with abundance of green fodder, seldom inclines to drink. Persons familiar with sheep husbandry know that in rich pastures that animal thrives very well for many weeks in the hottest summers, without any water but that which falls in the shape of dew; and if I mistake not, Captain Stansbury's mules travelled two whole days along the margin of Salt Lake, without food or water.

It is not the mere power of abstinence alone that so eminently fits the camel for travelling the steppe and the desert. His preference for the brackish and even saline waters which almost exclusively occur in those regions, and which are often so highly impregnated with mineral substances as to be rejected by most other quadrupeds, is a property almost as valuable. Russell even states that he prefers sea-water to

* Carbuccia, 10, 11, 89, 204.

† Denham and Clapperton, I. c. 3.

‡ The quantity of water swallowed by the camel, after long privation, is very great. I have seen one empty at a draught three goat skins, holding not less than seven gallons each; and Riley speaks of even much greater quantities. The camel smells, or by some other sense detects water at the distance of a mile or more; and the uncontrolled violence with which he rushes to the well to satisfy his thirst is one of the greatest inconveniences, not to say dangers, of desert travel.

fresh; but this is not confirmed by other authorities, and I have seen them, when parched with thirst, rush to the sea, wade into it, and turn from it with evident disappointment on finding the water salt.

The rate of travel of the burden camel is exceedingly uniform, and varies little in the different species and breeds of the animal. Rennelle, Robinson, and other inquirers, have very carefully investigated this subject, with a view to the use of the camel's pace in geography as a measure of distance. His speed is naturally modified by the nature of the ground, but as all irregularities of this sort are usually compensated in long journeys, it may be safely averaged at two miles and one third per hour. Over a smooth and level surface, I have found his ordinary length of step to be six feet, and the number of steps of each foot thirty-seven to the minute. This gives a speed of two miles fifty-two hundredths to the hour, under the most favorable circumstances; but upon rougher ground it was proportionately retarded, and I believe Robinson's estimate to be a very exact average.

The length of the caravan day's journey, when there is no special motive for haste, is regulated by the distance between wells and pasture grounds; but it is seldom less than ten, and more frequently twelve or fourteen hours, and in most countries the entire day's journey is accomplished without a halt. Averaging the hours of travel at twelve, the distance performed would be twenty-eight miles, and this rate may be kept up any number of days in succession.

This is the estimate for animals with full burdens, and left to their natural gait; but in case of emergency, and especially under lighter loads and fleeter camels, both the rate of travel and the length of the day's journey may be very much increased.

Bergmann states the ordinary day's journey of the loaded Bactrian camel at forty miles, and without burden at from fifty to sixty-five miles; and my correspondents in Bessarabia and the Crimea agree in stating that upon a good dry road a pair of Bactrians will draw a load of 3,000 to 4,000 pounds a distance of fifty miles without eating, drinking, or halting. These authorities, which I believe are entirely reliable, show that for transportation the Bactrian camel is superior to the Arabian; and it appears that when properly trained he is also capable of attaining a considerable speed under the saddle, though in this respect he cannot compete with the Arabian dromedary. Some of the Arab accounts of the fleetness of the maherry are no doubt fables, and one may well question whether Johnson's story of the dromedary that bore his master on an errand of love from Morocco to Mogador and back, a distance of 200 miles, in a single day, is not exaggerated. But the numerous well authenticated evidences of this animal's great speed and power of endurance, leave no doubt that in the union of these two qualities he far surpasses the horse, as well as all other domestic quadrupeds.

Mehemet Ali, when hastening to his capital to accomplish the destruction of the Mamelukes, rode without changing his camel, from Suez to Cairo, a distance of eighty-four miles, in twelve hours. A French officer in the service of the Pasha performed the same feat in thirteen hours, and two gentlemen of my acquaintance have accomplished it in less than seventeen. Laborde travelled the distance in the

same time, and afterwards rode the same dromedary from a point opposite Cairo to Alexandria, a distance of about one hundred and fifty miles, in thirty-four hours. But the most extraordinary well authenticated performance of the dromedary is that recorded by the accurate Burckhardt, under whose personal observation it fell. In this instance the animal carried its rider one hundred and fifteen miles in eleven hours, including twenty minutes spent in crossing and recrossing the Nile. Upon longer journeys the daily rate of the best dromedaries, though not equal to these instances, is still extraordinary. A French officer of high rank and character in the Egyptian service, assured me that he had ridden a favorite dromedary ninety miles in a single day, and five hundred miles in ten. Mails have been carried from Bagdad to Damascus, upon the same animals, four hundred and eighty-two miles, in seven days; and on one occasion, by means of regular relays, Mehemet Ali sent an express to Ibrahim Pasha, from Cairo to Antioch, five hundred and sixty miles, in five days and a half. But the most remarkable long journey on record is that of Col. Chesney, of the British army, who rode with three companions, and without change of camel, from Basrah to Damascus, a distance of nine hundred and sixty miles, in nineteen days and three or four hours, thus averaging fifty miles per day, the animals having no food but such as they gathered for themselves during the halts of the party.

The gaits of the dromedary are all properly paces or ambles; though in racing I have seen them break into an irregular gallop, as they also do for a short distance when hotly pursued by cavalry, and they then outstrip the horse.* The motion of the burden camel and the slow walk of the dromedary are necessarily violent, from the great length of step, and at first very wearisome to the rider; but a few days' practice accustoms him to this rough exercise, and he performs his day's journey with as little exhaustion as upon horseback. The quicker movements of the dromedary, at his average pace of five or five and a half miles an hour are much easier and less fatiguing than his walk, and a day's journey of fifty or sixty miles at this pace is an easy achievement. At much more rapid rates, however, the motion becomes again intolerably violent, and an inexperienced rider finds it almost impossible to cling to the saddle, or even to catch his breath, though at the ordinary speed the seat is more secure than on horseback.

The burden of the ordinary camel varies with the age of the animal, his breed, and training, and it ranges from three hundred and fifty or four hundred pounds for the lighter and more delicate of the Arabian camels, to twelve, and for moderate distances even fifteen hundred pounds for those bred by the Turcomans in Asia Minor. From six to eight hundred pounds would be a safe average, according to the weight of the animal and the smoothness or ruggedness of the route; and with the smallest of these loads the ordinary camel would easily surmount any mountain passes practicable to other beasts of burden. The weight of the pack-saddle, which is considerable, is excluded in these estimates. In some parts of the East the Arabian camel is employed as a beast of draught, and is even harnessed to the plough. I have seen

* Carbuccia, 16, 77. Bergmann *apud* Ritter, XIII, 691.

them employed for transporting heavy stone on carts in Egypt, and they have been not unfrequently used for drawing heavy ordnance. In general, however, the Arabian camel is employed altogether as a beast of burden. In Bessarabia the Bactrian camel is used for the plough and for draught, while in the Crimea he is used for draught alone, and is seldom or never ridden in either of those provinces. Throughout Chinese and independent Tartary, however, as well as in Siberia, the Bactrian camel, though sometimes harnessed to wheel carriages, is much more generally employed for the saddle or burden; and the prejudice which has extensively prevailed that the configuration and sensitiveness of the humps forbids the use of the pack-saddle for this species, appears to be without foundation.

In whatever mode the camel is employed, his harness is very simple. In some regions he is guided by a plain halter, in others the septum or one of the alæ of the nose is pierced, an iron ring inserted, and to this is attached a cord to serve as a bridle; and in the military service it has been found convenient to use the halter and this rude bridle in conjunction.* In the burden caravans the camels are not unfrequently tied head to tail, in files of about seven animals, the driver riding ahead upon a donkey or a camel, and the last camel in the file carrying a bell, so that the driver may be advertised by the ear if the chain by any accident is broken.

The pack-saddle, whether for riding or for burden, is made by stuffing a bag seven or eight feet long with straw or grass, doubling it and sewing the ends together. This forms an oblong ring, which is furnished with a rope crupper and placed upon the back so as to enclose the hump. Upon this cushion rests a frame consisting of two pairs of flat sticks meeting at top like a chevron or pair of rafters, and connected at bottom by a couple of sticks two or three feet long, secured to the others by thongs. The pad soon fits itself to the shape of the back and sides, and the frame nestles into the pad, while the hump rising in the centre of the whole apparatus keeps everything in place, so that no girdle, or at most a loose rope, is needed to confine the saddle. The load stowed in sacks, or better still in rope nettings, is balanced across the saddle, and the water-skins are suspended beneath.

The gear of the dromedary is somewhat lighter, but of the same fashion. The wooden frame is more neatly made, the uprights being curved outwards and uniting at top in two conical pummels, one before and one behind, six or eight inches high, and perhaps two in diameter at the base, covered with figured brass plate or otherwise decorated, and terminating in a knob. Over the saddle is thrown a large pair of saddle-bags of striped goat's-hair cloth, ornamented with fringes and cowrie shells, and upon this are laid blankets, cushions and carpets, and perhaps a gay housing over all. The rider is perched at the summit of this pyramid, directly over or perhaps a little in advance of the hump; and his stirrups, if he uses them, his water-bottle, his gun, a smaller pair of saddle-bags or a carpet-bag, or any other convenience he may choose, are hung to the pommels. In riding the maherry, how-

* Carbuccia, 44, 45, 50, 51, 133. According to Erman and Father Huc, the Northern Tartars pierce the septum of the nose and insert a piece of wood or bone, to which they attach the reins of the bridle.

ever, the wilder tribes sit on a small saddle placed upon the shoulders, in front of the hump, and sustain themselves in their seat by crossing the ankles over the neck.*

As the camel lies down to receive and discharge his burden, he is very quickly and conveniently loaded and unloaded; the latter operation generally consisting simply in loosing a knot of the cord by which the packages are slung across the saddle, and the camel then immediately rises and goes in search of pasture. On returning to the camp at veening he lies down between the packages; and if these consist of merchandize or other articles not requiring to be opened at night, the driver has only to knot the cord again, and the animal is ready for the march. The pack-saddle is very rarely removed; and as the camel very seldom stretches himself on his side or attempts to roll, the saddle is never lost.

For draught he is simply yoked to the pole of the wagon, just as the ox is with us, and requires no other gearing. This extreme simplicity and economy of harness has, with trifling modifications, been carried into the military service by the French in Algeria, and wherever else the camel has been employed in war, and is found to answer all purposes as completely as the costly furniture with which we supply our cavalry. Every soldier may be his own saddler, and he requires no material but bagging, straw or grass, a little cordage, and a few small sticks, which may be found wherever there is any arborescent vegetation, to extemporize at an hour's warning the complete equipage of his beast.

The training of the camel commences when he is quite young, and, as his *manège* is very simple, it is soon completed. At the close of his third or early in his fourth year he is in his full strength, and the period of his service begins earlier and lasts longer than that of the horse. In Algeria he never attains a greater age than thirty years, and he is fit for labor for about fifteen or twenty years. In Syria and Asia Minor his ordinary life and service is ten years longer; while in the Crimea, as I am assured by a Russian officer of great experience in the use of the animal, the Bactrian sometimes lives to a hundred, and, upon an average, to sixty or seventy; though another correspondent in Bessarabia states the ordinary term of his life at thirty-five years.

The average height of the Arabian camels I have measured was nineteen hands, or six feet four inches, to the top of the hump, the head being an inch or two higher. The tallest I have used measured seven feet and seven feet three inches respectively. The very powerful Turcoman camel is somewhat lower than the Arabian, and the height of the Bactrian is stated at from six to eight feet, his weight at one third more than that of the ox, which in the Crimea is estimated at nine hundred pounds, making the weight of the camel twelve hundred; and I was informed at Pisa that the camels of the grand duke's stables sometimes weighed fourteen hundred pounds.

The swift dromedary varies much in size. Layard mentions a deloul (the name of this variety in the Syrian desert) from the Nedjd, where very fine animals are raised, which was little taller than an Arab horse;† and all the true Arabian dromedaries I have met were very

* Lyon's Travels, 114. † Layard: New Researches, 332.

small. The hedjin, a dromedary of the upper Nile, on the contrary, is much taller, frequently, I am sure, not much below eight feet; and the maherry of the great desert is taller still. Lyon speaks of a Tibboo maherry of seven feet eight inches as small; and on one occasion a dromedary of this variety, measuring not less than nine feet and a half, was brought to the camp of Captain Denham.*

The most common colors of the camel are mouse, drab, and fawn; but black and white animals occur, and a very delicate and pleasing rose tint is not uncommon among the high-bred dromedaries of the greater Arabian peninsula.

The milk of the camel is a very favorite drink in all countries where the animal is used, and it is highly salubrious and nutritious. Some tribes possessing large herds live wholly upon it during a great part of the year, and it is very frequently given to favorite horses, which are extremely fond of it.† My own curiosity never led me to taste it, but the ladies of my party drank it constantly for many weeks, and found it both agreeable and refreshing; though, when the pasturage was particularly dry and spicy, they thought it rather too highly flavored with the aromatic savors with which, as poets sing, even the air is charged in Araby the blest. The quantity given in the desert without green food is small, certainly not exceeding a quart; but the Bactrian camel, which enjoys in general a more succulent diet, yields twice as much.

The utility of the camel does not cease with his life. His flesh, especially the hump and heart, is a favorite food among all camel-drivers, and when the animal is in good case it is described as little inferior to beef; but in the desert the camel is seldom killed until it is almost ready to die of exhaustion, and European travellers have found it in that condition tough and ill-tasted. The skin varies in thickness and strength with the breed, and is found of all qualities from that of the horse to the toughness and solidity of sole leather. Athough I have seen camels regularly sheared, yet, in general, the hair is wrenched off by hand at the time of shedding the coat. In southern latitudes the quantity is small, and the fibre short and coarse; but the Bactrian yields a fleece weighing ten pounds, of longer and finer fibre; and there are varieties in the basin of the Caspian with long silky hair scarcely inferior in quality and value to the wool of the Cashmere and Thibet goat. These breeds would be well worth introducing for the fleece alone.‡ The tallow is hard and firm, and for candles scarcely inferior to spermaceti or wax,§ and the bones would, no doubt, be found of value in the arts.

The Arab holds the camel and the date-palm to have been formed out of the same clay as our common father Adam, and to have proceeded more immediately from the hand of the Creator than any other quadruped or tree; and he believes he shall meet them again in Para-

* Lyon: Travels in Africa, 313. † Denham and Clapperton, I, 169.

‡ Father Huc. (American edition,) I. chap. 9, Ritter XIII, 676, 654. Erman, Reisen, I. 198, speaks of the camel's hair shawls brought to the fair of Nishnei Novgorod from Bokhara as of the most extraordinary fineness and beauty. They are made of the hair or rather wool combed from the belly of the animal, and spun into yarn as fine as human hair, and are sold at higher prices than the most delicate Cashmeres.

§ Carbuccia, 82—Ritter XIII, 692.

dise. Mohammed proclaimed his dispensation from the back of a camel, and was translated to Paradise by the same conveyance.

The camel alone is permitted to carry the sacred veil to Mecca, and he serves as the pulpit from which the Cadi preaches at Mount Ararat the annual sermon to the pilgrims to that holy spot. Notwithstanding these high claims, the Arab seldom pets his dromedary as he does his horse.

Beyond an occasional handful of food, and a dressing of the snows of the extreme north, he is never housed or otherwise sheltered in any of the wide range of climates through which he roves. To the extremest heat of an African sun the Arabian camel is utterly indifferent; and the Bactrian braves, without shrinking, the chilling frosts and the icy blasts of northern Siberia. I have often watched the camel's habits in this respect in the desert, and though we sometimes encamped near palms and other trees, or where he would readily have found a shelter beneath the cool shadow of a rock, I could never discover that, even under the most glaring light and scorching heat, he at all preferred the shade to the sun.

The camel, though less vicious than the horse, is not altogether so patient an animal as he is generally represented. His anger is indeed not easily excited, but when once thoroughly irritated, he long remembers the injury which has provoked him, and the "camel's temper" is a proverbial expression used by the Arabs to denote a vindictive and unforgiving disposition.* Although he sometimes strikes with the fore foot, yet the hoof being unarmed, his blows are feeble, and his only dangerous weapon is his teeth. These are used with powerful effect in the barbarous fights which are sometimes got up as spectacles, but it is only under certain special circumstances, which are easily avoided, that he attacks his driver.

His only ordinary manifestation of discontent is the harsh and ill-natured growl he sets up whenever he is approached to be loaded or mounted, and especially when any attempt is made to overcharge him. In the stillness of the desert the growl of a caravan, preparing for the morning's march, is heard for miles around; though the true maherry seldom growls, and it is said there are breeds which have entirely lost this disagreeable peculiarity; yet, in general, silent as is the march of a burden caravan, its halts are very unmistakeably announced to all wanderers within a long distance of its track. So harsh indeed is the growl of the camel, that Father Huc gravely declares that his camel-driver, on one occasion, put a pack of wolves to flight by tweaking his camel's nose till he roared again.†

The Arabs habitually travel much by night, and this not, as has been supposed, for the sake of the guidance of the stars, which they seldom need, but partly to avoid the greater heat of the day, and more especially to allow the camel, which never feeds by night, the day-

*Höst, an accurate observer, says, (Efterretninger om Marokos, 269,) that the Sultan of Morocco had camels trained to act as executioners, and all writers concur in representing the male as dangerous during the rutting season. According to Carbuccia, pp. 7, 8, 83, this paroxyism is calmed by tarring the head of the camel, or permanently prevented by a simple process attended with little inconvenience, and no danger to the animal.

† Father Huc, I, chap. 3.

light for gathering his food.* It is common to start from midnight to two o'clock, and to march, without halting, ten, fifteen, or sometimes twenty hours, after which the camp is formed; and if it is not yet dark, the camels are turned out to graze till sunset, when they return to the camp, are hobbled, by tying up one of the folded fore legs, and ruminate and sleep to the hour of departure. Although so long a day's journey without pause is fatiguing to the rider, yet, except with light dromedaries, experience is in favor of the practice. To halt without unloading the camels would afford them no relief, but fatigue them the more by practically lengthening their day's work; and if they are unloaded and allowed to wander in search of food, the time lost in collecting them and rearranging their burdens would bring the caravan too late to the camping ground. Where, however, the party, as is the case with military expeditions of a few days' length, is unaccompanied by burden camels, and the dromedaries are loaded with only the equipage, water, and provisions of their riders, the hours of travel and repose can, without inconvenience, be arranged and varied to suit the exigencies of the occasion.

The question of the practicability and advantages of introducing the camel into the United States for military and other purposes, is one of much interest and importance; and I hope I shall be pardoned if I prolong a discourse, which I fear has proved but a dry one, for the sake of suggesting some considerations upon a topic to which I have devoted some attention, both at home and abroad.

Among those who are practically familiar with the habits and properties of the camel, and who have studied the physical conditions of our territory west of the Mississippi, there is, I believe, little or no difference of opinion on the subject; and I am persuaded that the ultimate success of judicious and persevering effort is certain, and will be attended with most important advantages. At the same time, it must not be concealed that, as much depends on a point that nothing but experience can determine,—the selection, namely, of the particular breeds best adapted to our climate, soil, and other local conditions,—the result of a first experiment, unless tried on a liberal scale, and with animals of more than a single variety, is extremely uncertain. The question must be considered under two aspects: the one regarding the camel as simply a beast of burden; the other, his value as an animal of war. But even if it is conceded, which I by no means admit, that the organization of a proper mounted dromedary corps is impracticable or inexpedient, it does not, by any means, follow that the camel may not be of great value in the commissariat, and in all that belongs to the mere movement of bodies of men, as well as in the independent transportation of military stores and all the munitions of war.

The first question to be discussed is the adaptation of any variety of either species to the climate and soil of any portion of our territory. So far as mere extremes of temperature are concerned, it is quite certain that we have nowhere, west of the Mississippi, fiercer or more long-continued heats, more parched deserts, or wastes more destitute of vegetation, than those of the regions where the Arabian camel is

* Fraser, Khorasan, 379.

found in his highest perfection; and the Bactrian thrives in climates as severe as even the coldest portion of our northeastern territory.

There is, however, it must be admitted, one point of difference between our general climate and that of the eastern continent which has an unfavorable bearing on the question. I refer to the greater moisture of our atmosphere and the greater frequency of rains during the summer season. In general, the countries where the camel thrives have a proper dry season, little or no rain falling during the summer months. But to this rule, there are exceptions. The valley of the lower Danube has summer rains, and a very wet autumn, winter, and spring; and many northern Asiatic districts are subject to similar climatic conditions. But the objection, whatever may be its force, seems to apply merely to the proportion of the year during which the animal can labor, and not to its influence upon his constitution; because, it appears that in the cold and damp Russian provinces the camel is less subject to disease, and attains a greater longevity, than in any other part of the world; and it is remarkable that in the Crimea, at least as I am informed, he is little used in the hottest and driest season, because the heat is found too great for that variety, and his services are most valuable in winter.

On alluvial and other soft soils caravans using the camel will, no doubt, be obliged to halt during rains and until the ground is dry; but upon all other surfaces, one or other of the species may be used without regard to weather or season; and as none of the passes of the Rocky mountains are more rugged or steeper than those of Arabia or Tartary, there is every probability that he may be advantageously employed over all the known routes between the Mississippi and the Pacific coast.

In reference to the special properties of the different varieties it may be observed that, although, as we have already seen, the Arabian camel traverses the roughest routes and climbs exceedingly steep ascents, yet the Bactrian and the cross between the two species are even better fitted for scaling difficult mountain passes. This difference is, probably, partly due to habit and training; but the greater elongation of the toe of these breeds, which sometimes projects beyond the cushioned sole and forms a sort of claw, undoubtedly somewhat facilitates climbing by giving a grasp to the foot-hold, for which reason the Bactrian anciently was, and sometimes still is, called the mountain camel.

My Russian correspondents, to whom I have so often referred, say that the Bactrian is chiefly used for winter transportation, and that his feet require no protection, but, to use their own words, are so formed that he travels well not only on frozen ground, but upon ice and snow. Timkowski saw caravans of this breed cross a glacier; and Bergmann says that, in winter, the Calmucks prefer them to horses for the saddle, because their long legs enable them to wade through deeper snows, and adds that they bear severe cold better than the horse, the ox, or the sheep.

Father Huc and Pallas give similar accounts of the power of the Bactrian camel; and Pallas adds that he is used not only in deep snows and half-frozen morasses, but that he fords rapid torrents, and, with a little training, even swims well.

In the month of February, Erman saw, at Kiachta, on the Russo-Chinese frontier, herds of camels in the open air, feeding on withered and frozen wild vegetables, at a temperature of 25 degrees below zero of Fahrenheit, and remarks that they fear neither the severe winter of Siberia nor the parching summer heats of the sand-wastes of the desert of Gobi. The alternation of thaw and frost alone, says he, is dangerous to them, in consequence of the icy crust formed under such circumstances, which wounds their feet and limbs.

So numerous is the camel in these frozen realms, that almost the whole commerce between Russia and China, by way of Kiachta, is carried on by means of them; and they transport merchandise over the whole of the vast distance between Orenburg on the Ural, and Petropawlowsk on the peninsula of Kamtschatka. In the month of October, Timkowski met on the desert of Gobi, in latitude 46°, and at the height of 2,500 feet above the sea, a herd of 20,000 camels; the Russian expedition against Khiva and Bokhara, in 1840, employed more than an equal number; and Berghaus estimates the number of camels in European Russia at not less than 100,000.

So far, then, as climate and soil are concerned, it may be regarded as quite certain that the Bactrian camel can sustain any exposure to which he would be subjected in our trans-Mississippian territory; and there is no reason to doubt that the mezquit, acacia, and other shrubs, and the saline plants known to exist in many of those regions, would furnish him an appropriate and acceptable nutriment.

I cannot speak with equal confidence of the ability of the Arabian camel, and especially of the maherry of the desert, to bear corresponding trials. All high-bred animals are delicate, and impatient of exposure to great extremes and sudden changes; and although Denham and Clapperton speak of hard frosts in latitude 13° north, and Lyon records a temperature four degrees below the freezing point, in districts constantly traversed by the maherry, yet the finest and fleetest animals will not bear the winter climate of Algiers.* But, although we may not be able to breed dromedaries of a speed equal to the most extraordinary performances I have described, there is no reason to doubt that the more common animal, which will travel eight or ten hours a day at five miles an hour, for many days in succession, and with greater speed for a shorter period, can be bred and used with advantage throughout our southwestern territories, and on all the more southern passes of the mountains which divide the valley of the Mississippi from the Pacific slope, as well as throughout the State of California.

The ancient Asiatics, and, at a later period, the Romans, made a very extensive use of the dromedary in war, not only for the transportation of men and munitions, but as technical cavalry in actual combat; and they are still employed in Persia, Bokhara, and Tartary, for military purposes, and especially for the conveyance of light pieces of artillery, which are mounted between the humps, and used in that position, the camel kneeling while the gun is loaded, aimed, and fired. In modern European armies they have hardly been employed, except by Napoleon, in transporting the baggage of his army in the Syrian cam-

* Carbuccia, 4.

paign, in his celebrated dromedary regiment; and, more recently, by the army of occupation in Algeria. Upon the march from Egypt to Syria, the baggage, the camp equipage, and the sick,* of an army of 15,000 men, were transported solely by camels.

It is remarkable that the military archives of France furnish little or no information, beyond the mere number of the corps, respecting the dromedary regiment of the army of Egypt, the historical documents belonging to the subject having been chiefly lost or suppressed; and all we know concerning it is derived from an imperfect and erroneous account in the great work on Egypt, and a late paper by Gourard, one of the savans who accompanied the expedition. Without entering into minute detail, it must suffice to say that this regiment, which numbered something less than 500 men, was organized in the main like a regiment of cavalry, and performed the same general service, with the most brilliant success.. Although the men were taken from the infantry, a very short time was required to teach them the new discipline and drill, and the animals were habituated to the necessary evolutions in an incredibly short space of time. The services rendered by the corps were of a most important character, and its performances, according to Prétat, were quite unprecedented in military annals. This officer states that the ordinary march of the regiment was thirty French leagues, or about seventy-five miles, *without a halt;* and that a detachment belonging to it marched six hundred miles in eight days. These latter extraordinary statements rest on the testimony of a single individual, and though the corps was composed wholly of picked animals and picked men, and animated by the energy of a Bonaparte, it is very difficult to yield them full credence.

The experiments in Algeria, though satisfactory to the officers charged with them, whose reports seem entirely conclusive upon the value and economy of the camel as an animal of war, have been attended with less brilliant results. The prejudices of the officers and men against the use of this awkward and ungraceful animal in the regular service have proved very difficult to overcome. The peculiar organization of the French commissariat has interposed serious pecuniary obstacles, and the government has always seemed disinclined to consider this question in a spirit of liberality and candor. It is, however, proved that the use of the dromedary contributes in a most important degree to the economy, the celerity, and the efficiency of military movements in desert regions; and I cannot doubt that it would prove a most powerful auxiliary in all measures tending to keep in check the hostile Indians on the frontier, as well as in maintaining the military and postal communication between our Pacific territory and the east.

There are few more imposing spectacles than a body of armed men advancing under the quick pace of the trained dromedary; and this sight, with the ability of the animal to climb ascents impracticable to

* For the transportation of the *wounded* the camel is not so suitable, on account of the roughness of his motion; but, for even these, the *tachtirawan*, or litter borne by two camels, would probably answer. Invalids often travel, as I have witnessed, in a *cajava*, or, as it is sometimes called, a *mahafa*. This consists of a pair of boxes or frames, properly with a canvass sacking, five feet long, two wide, and two deep, slung across the pack-saddle, and protected by an awning. A strong camel will carry two persons in this way.

horses, and thus to transport mountain howitzers, light artillery, stores, and other military matériel into the heart of the mountains, would strike with a salutary terror the Comanches, Lipans, and other savage tribes upon our borders.

The habits of these Indians much resemble those of the nomade Arabs, and the introduction of the camel among them would modify their modes of life as much as the use of the horse has done. For a time, indeed, the possession of this animal would only increase their powers of mischief; but it might in the long run prove the means of raising them to that state of semi-civilized life of which alone their native wastes seem susceptible. The products of the camel, with wool, skin, and flesh, would prove of inestimable value to these tribes, which otherwise are likely soon to perish with the buffalo and other large game animals; and the profit of transportation across our inland desert might have the same effect in reclaiming these barbarians which it has had upon the Arabs of the Siniatic peninsula.

Among the advantages of the camel for military purposes, may be mentioned the economy of his original cost, as compared with the horse or mule, when once introduced and fairly domesticated;* the simplicity and cheapness of his saddle and other furniture, which every soldier can manufacture for himself; the exemption from the trouble and expense of providing for his sustenance, driving, sheltering, or shoeing him; his great docility, his general freedom from disease,† his longevity, the magnitude of his burden; and the great celerity of his movements, his extraordinary fearlessness,‡ the safety of his rider, whether from falls§ or the viciousness of the animal, the economical value of his flesh, and the applicability to many military purposes of his hair and his skin, the resources which in extreme cases the milk might furnish, and finally his great powers of abstinence from both food and drink.‖

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* The price of the camel is exceedingly low in all countries where he is bred. Except for the highest breed, maherries, it nowhere, except in the Crimea, exceeds fifty dollars, and is in general considerably below this sum. The reason of this is that it costs nothing to breed the animal. The dam continues to labor during the whole period of gestation, (which runs according to climate, from eleven, or in some cases, ten to twelve months,) and even the dropping of a foal scarcely delays her march. (Denham and Clapperton, I. c. 3, Ritter XIII, 610.) The young requires no care and little training, and is already serviceable in his third year.

† According to the concurrent testimony of all observers, no domestic animal is so free from disease as the camel. General Harlan's statement, that he is more liable to maladies than the horse, is unsupported by any other writer, and it must rest on some local peculiarity of climate or of breed. My correspondents in southern Russia describe the Bactrian as almost completely exempt from all ailments. In Algeria the camel suffers much from the sting, or more properly the oviposition of an insect; and it might be important, in importing the animal from that country, to select a season when he is free from the egg and the larvæ, in order to avoid introducing the insect with the camel.

‡ Carbuccia, 25, 168.

§ The security of the seat, though at once *felt* by all who have mounted the camel, seems hardly reconcilable with the violence of his motion, and is not easily explained; but nothing is more rare than a fall from his back. Every oriental traveller can testify that the Arabs often sleep upon their camels when on the march, and Colonel Chesney (Expedition to the Euphrates, II, 671) and Layard give curious accounts of the preparation and even cooking of food on the backs of the camels by the Arab women, during forced marches. They even contrive to milk the milch animals without halting.

‖ The use of the camel has enabled the corps which have employed it in Algeria to dispense altogether with a baggage train, as the animal can transport a very considerable burden, in addition to the soldier and his accoutrements, at a much more rapid rate than the ordinary march of a column of infantry or artillery.

I may add another advantage, which will be appreciated by all who know the difficulty of conducting a caravan of mules or horses across the plains. I mean the security from stampedes and other nocturnal alarms and losses. The dromedary is a much less timid animal than the horse or mule, and he is not sufficiently gregarious in his habits to be readily influenced by a panic terror. The mode by which he is confined at night furnishes a complete security against escapes from fright or other causes. As he lies down, he folds the forelegs under the body. The Arab passes a loop around one or both of the folded limbs, above the knee, and secures the end of the cord around the neck. When both legs are thus shackled, the camel can rise only to the knee: if one only is hobbled, he rises with difficulty, and moves very slowly; and if an Indian were to cut the loop, and thus free the animal, and even succeed in mounting him, he would not be able, without a previous practice, which he has not the means of acquiring, to put him up to such a speed as to elude pursuit.* There is another point which I have never heard insisted on, but which has often struck me with some force in riding the camel. I mean the greater range of vision which, in a level country, the greater elevation of the seat gives the rider. The eye of a horseman is upon an average scarcely eight feet above the ground. Upon the dromedary it is two feet higher, and commands a wider range accordingly.

To all these advantages I am aware of no drawbacks but the expense of introducing the animal and experimenting with him, and the difficulty of accustoming horses to the sight of him. The first objection is too trifling to be debated in a case of so much importance; and though the latter has been found formidable in Tuscany, and according to Father Huc, even in Tartary, where the camel has been very long in use, yet it is of no great force as applied to the sparsely populated regions of the Far West, and as the multiplication of the animal would be gradual and slow, it is not likely that any great or general evil would flow from this source.

The facts I have recited seem to me abundantly to warrant the conclusion that at the least the experiment is worth trying, and it is highly desirable that it should be tested on a scale large enough and varied enough to embrace all the chances of success.†

For transportation, the choice would lie between the Turcoman camel of northeastern Asia Minor and the Bactrian. The former might easily be procured at Aleppo, and shipped at Alexandretta, or perhaps better at Trebizond, on the Black sea. The Bactrian, which seems

* The only serious inconvenience attending the use of the camel in marching through a country inhabited by hostile Indians, is the necessity of allowing him to wander in search of food; but as he habitually returns to camp before sunset, of his own accord, and never feeds, and very seldom stirs during the night, he would require to be watched only for a couple of hours during the whole twenty-four.

† Very full information on the military qualities and the hygiene of the Arabian camel, upon the dromedary regiment of the army of Egypt, and the use of this animal in war by the ancients, may be found in the work of Carbuccia I have so often cited, and the papers of Gourard appended to it. The title is: Du Dromadaire comme bête de somme, et comme animal de guerre; par le Général G. L. Carbuccia. Paris, 1853. The appropriation made by Congress for introducing the camel ($30,000) will prove hardly sufficient, it is to be feared, for trying the experiment on a sufficiently liberal scale; and it is therefore doubly important that advantage should be taken of the knowledge acquired by the French in their African possessions.

on the whole the more promising animal, might most readily be obtained at Odessa, or in the Crimea; but, as the camels of those provinces are trained only for draught, it would be more advisable to procure them from the Calmucs, in the neighborhood of the Caspian, where they are used for burden and for the saddle, and, according to Bergmann, possess great speed, and they could be shipped at some of the ports of the sea of Azow, or they might perhaps, with even greater convenience, be bought at Petropawlowsk, on the Pacific, at the season of the visit of the caravans, and landed in California.

The dromedaries should be brought from Algeria rather than from Egypt, because they are there accustomed to much severer winters, a moister climate, and a rougher country; and the experience of the French military service in the use of them might be of great value in aiding in the selection of the breeds or individual animals, as well as in furnishing patterns of the best harness and gearing. The number of each ought to be at least sufficient for the organization of a small regular corps, to be trained in the use of them, and the officers should be provided with all the information which can be gathered from Asiatic and European experience on the subject.

"If," says General Marey Monge, "cavalry had been unknown in France, and we, seeing the great advantages derived from it by the Arabs, had now for the first time attempted to introduce it into our military service, we should have had a thousand difficulties to overcome. Objections would have been made on the score of kicks and bites, errors would have been committed in the choice of saddles and bridles, the horses would have met with accidents or contracted ailments from our want of experience and ignorance of farriery; in the first engagements, our mounted men would have been thrown or run away with, they would have been clumsy in managing their arms on horseback, and probably been roughly handled by the superior skill of the Arab horsemen. A party would have been formed against the innovators, who would themselves have become disgusted, and the attempt to introduce mounted corps would perhaps have been abandoned; but if, in spite of accidents, mistakes, and losses, we had persevered, we should have ended by forming what we have now, an efficient and excellent cavalry."

This argument is as valid with us as it was in Algeria; and if the experiment shall be tried in the United States without success, it will probably fail for reasons as specious but as inconclusive as those which General Monge supposes against the introduction of cavalry into the French military service.

NOTE.—A late writer in the Révue Orientale, 1280, says: "I knew in Egypt a camel driver who had bought a dromedary belonging to a sherif of Mecca, deceased, at Cairo. This animal often made the trip between the latter city and Suez, going and returning in twenty-four hours, thus travelling a distance of sixty leagues in a single day." [The performance of the dromedary is rather understated. The actual distance between Cairo and Suez is *eighty-four* English miles, and the animal must consequently have accomplished one hundred and sixty-eight miles in twenty-four hours. He remained four hours at Suez for rest, and therefore travelled at the rate of eight miles and four tenths per hour.]

LECTURES.

No. II.—ON THE NATURE AND CURE OF THE BITE OF SERPENTS AND THE WOUNDS OF POISONED ARROWS.

BY DR. DAVID BRAINARD, OF CHICAGO, ILLINOIS.

Among the many points in which the science of the present day surpasses the knowledge of past centuries, there is none more conspicuous than that which relates to the nature, the effects, and the means of detecting poisonous substances.

To be convinced of this we have only to cast a glance at the state of society in the latter part of the sixteenth century, the time of Charles IX and Henry III, of France.

At that period Italian manners and customs had been introduced into France by Catharine de Medici, and with them the knowledge of those poisons whose use, in Italy, had rendered the names of certain families pre-eminent in the annals of infamy.

The most distinguished surgeon of the sixteenth century, Ambroise Paré, has left us, in his works, a very curious account of the means resorted to by the Italian perfumers to convey poisons in a manner which should not be suspected.

Paré was the surgeon of Charles IX, and, being a Protestant, was saved from the massacre of St. Bartholomew, concealed in the cabinet of the king in the palace of the Louvre, at the time when the signal for the slaughter was sounded.

The object of the monarch in saving his life was to have the benefit of his superior skill as a surgeon, and especially in the art of detecting poisons and counteracting their effects.

Paré states that poisons are, "by the artifices and sublimations of the wicked traitors, poisoners, and perfumers," deprived of their bitter taste, and even rendered agreeable to the palate, while they are so concentrated as to prove fatal in a short time, and so subtle as to defy the efforts of the most skillful to detect them.

In relating the case of Pope Clement, who was poisoned by the vapors of a torch, he says that flowers and odors of any kind were often used to convey the fatal influence; and that every prelate, beneficed clergyman, or other person whose wealth or rank promised advantage to any who might compass his death, lived in constant dread of poison.

A whole chapter of his work on medicine and surgery is devoted to the means of guarding against being poisoned. He advises the avoiding of all sauces, and especially those which are sweet, salted, or in any way pungent; and, in like manner, being thirsty, not to drink in large draughts, or to eat greedily, but to consider well the taste of what is eaten or drunk. "Moreover, we should eat," says he, "those things which break the force of venoms before each repast, and particularly a fat soup made of good meat," and only take wine or other drinks after having eaten. He counsels taking in the morning mithirstate or theriaca, with a little good wine or malvoisie, or the leaves of rue with a

nut and dried figs, which, he adds, "are remedies of singular efficiency." And "let not those who have a suspicion of having been poisoned, sleep; for the force of the venom is sometimes so great, so contrary to nature, that it exerts its power, and its effect in the body is like that of fire in dried straw."

"The true way to avoid poisoned perfumes," he adds, in concluding, "is never to smell them; to fly such perfumers as you would the plague, drive them out of the kingdom of France, and send them among Turks and infidels."

Modern science has revealed the nature of these poisons so subtle, so mysterious, and so dreaded.

The torch of chemistry has explored the secret chambers of those "wicked poisoners and perfumers."

Armed with its light the law is enabled to cast a shield around every individual, and give to the humblest a consciousness of safety which, in former times, the most powerful could not enjoy.

But science in this respect is not yet perfect. There are still substances mysterious, subtle, and dangerous, for which neither tests nor antidotes have been discovered. Many of the savage tribes of America possess the art, unknown to civilized man, of imbuing their weapons with a substance so deadly that a slight wound from one of them is dangerous, if not fatal.

The venom of serpents, the smallest drop of which brought in contact with the blood in the system is fatal, cannot be distinguished by chemical tests from the most harmless mucus or saliva.

There is reason to believe that this venom is sometimes employed by man; that he arms himself with the substance bestowed by Providence on the serpent for its defence, and uses it for the purpose of procuring subsistence or satisfying his destructive instincts.

Of the serpents which are furnished with this poison, the most common and dangerous is the crotalus, or rattlesnake, several varieties of which are found in the western and southern States of the Union, where they constitute an object of dread, and a source of danger to the first settlers of the country.

The rattlesnake derives its name from the peculiar structure of its tail, on which are arranged a number of rings called the rattle, with which a sound is made not unlike the buzzing of the wings of certain insects. The number of these rings increases with its age; but it is not certain that they correctly indicate the number of years it has lived.

The rattle is generally sounded whenever the serpent is angry, so that those familiar with the noise may avoid the danger; but in many instances the wound is inflicted without any warning being given.

The rattle itself is to be regarded as a means of defence in addition to the fangs and venom; for the peculiar note which it produces is terrifying to most animals, and they shrink from it with instinctive fear.

It seems to have been regarded by some of the aboriginal inhabitants of America as highly ornamental, for it is one of the objects which the natives of central America have most frequently represented in the carvings of stone with which they decorated the front of their temples.

The apparatus by which this serpent inflicts a wound and deposits

the venom within it, excels in delicacy and perfection any instrument for inoculation which human ingenuity has as yet been able to devise.

It consists of moveable fangs or teeth placed one or more on either side of the mouth beneath the upper jaw.

They are exceedingly sharp, curved, and move upon a hinge, so that, when in a state of repose, they lie with the point backwards, almost covered by the membrane of the mouth. The fang is perforated at its root by a canal which terminates near the point in a groove.

It is through this that the venom is ejected so as to be thrown, not upon the surface, but deposited at the bottom of the wound.

When about to strike, the fangs are raised so as to project directly forward, and the serpent coils himself so that, in the act of straightening, the head is thrust with great force a distance of about half his length. At the moment when the fang is most perfectly projected, the same muscle which elevates it presses also on the sac which contains the venom and ejects it, through the canal of the tooth, with force; so that, if the object is not attained, it is thrown to a certain distance, and may be seen falling in drops.

If the object aimed at is attained, as soon as the the teeth are inserted they are turned backward and drawn through the flesh like hooks to lacerate it. Indeed it often happens that the animal bitten, by a sudden movement draws the serpent after him, or that the fangs themselves are left in the wound.

The serpent, too, with the subtle instinct of his nature, as soon as the wound is inflicted, coils himself so as to resist being moved and thus inflicts a severe injury.

Nature, as if this weapon were indispensable to the species, has provided in the most ample manner for its indefinite reproduction when accidentally removed or shed at stated periods.

There exists at the side of the principal teeth in use, several others in different stages of development, which, in case any are shed or removed, grow and supply their place.

The gland which forms the venom corresponds to the largest of the salivary glands in man. The duct through which it is discharged is enlarged so as to form a reservoir capable of containing several drops, which may be kept in reserve.

That the saliva of one class of animals should contain the most concentrated venom, while that of others is the mildest of fluids, presents a contrast of the strongest character; but a certain analogy can be traced even in this instance, for in all animals when rabid, the saliva becomes poisonous, and in many, as in men, it sometimes assumes a certain degree of activity which renders it dangerous from the effect of anger alone.

The venom of the rattlesnake is a fluid of the consistence and color of olive oil; it has a peculiar and disagreeable odor, and is said to have a pungent taste.

There is no chemical test by which it is distinguished, nor are any peculiar appearances to be observed in it by the most powerful microscope.

It may be swallowed without danger. All the venom which could be extracted from several serpents mixed with water and poured into

the mouth of a young bird in the nest when it opened its beak for food, did it no injury.

Persons bitten by serpents generally experience, as the first effect, an intense pain in the part wounded—vertigo, nausea, fainting, and coldness.

If the venom has been inoculated directly into a vein, these symptoms terminate in death in a short time. If not, the part swells, becomes discolored, spotted over the surface of the member, and sometimes over the entire body.

The swelling is sometimes very great, extending over a large surface; but the heat and inflammatory reaction which accompany it are of a low grade.

If the amount of venom which has been deposited be small, or the wound has been properly treated, the swelling after having reached a certain point slowly subsides, but the part affected remains for a long time indurated. It has even been supposed that the extraordinary enlargement known under the name of elephantiasis is in many cases a remote effect of this wound.

As soon as the swelling commences to subside, another danger threatens the patient, viz: passive hemorrhage. The constitutional effects of the poison are such that they produce a dissolved state of the blood like that which exists in scurvy. Hence bleeding is liable to occur from the mouth, lungs, bowels, ulcerated surfaces, or the slightest wounds, or from all these at a time.

In a case which occurred in the Illinois general hospital, the blood which flowed from the gums was found so entirely destitute of fibrine, the principle upon which the coagulation depends, that no trace of it could be detected under the microscope. At this state the breath exhales a fetid odor, which is not only sickening at the moment, but which is said to have produced serious illness in those exposed for a length of time to its influence.

Bites which occur about the face are much more dangerous than those upon the extremities.

This discoloration results from the dissolved state of the blood which gives rise to hemorrhage, mortification, and death.

Nevertheless, the bite even of the most venomous species of serpents is not invariably nor even generally fatal.

There are seasons when they are inactive and inflict but a slight wound. The venom is at times much less virulent than at others, or it may have been exhausted by repeated bites. Small serpents have not sufficient force to penetrate the skin, and bites where the skin is thick or covered with clothing are least dangerous.

On the other hand if the serpent be old, of large size, and the bite occur in the commencement of summer, the danger is very great.

There is reason to believe that the poison used by the Indian tribes on their arrows, is, in many cases, nothing else than the venom of the serpent preserved in a peculiar manner.

Mr. Schomburgh himself says that the belief, that animal poisons entered into its composition was so rooted in Guiana, that on the occasion of his second visit, in 1837, he was unable to eradicate it.

Messrs. Bernard and Pelouze, in a memoir presented to the Academy of Sciences at Paris, in 1850, express the opinion that it acts in the

manner of a venom, that is an animal poison. They state that M. Goudot, who furnished them with the specimen they employed, had resided many years in South America, and was fully aware of the method of its preparation, and that he assured them that the poison of the most venomous serpents constantly entered into its composition.

He even described the manner of taking the serpents, and extracting the poison.

An intelligent traveller in California informs me that the Digger Indians in that State possess the art of poisoning their arrows, and that the substance which they use for the purpose is well known to be obtained from the rattlesnake.

Dr. George Johnson, of St. Louis, also told me that several tribes of Indians on the Rio Grande employ the venom of the serpent for this purpose, and that there is a species known to them which have the vesicles receiving the venom so large as to contain a quantity sufficient to poison a great number of arrows.

An intelligent missionary, who had resided many years in the East Indies, states that the traditional account of the method of preparing the woorara of that country is, that the venom of serpents is mixed with it to form the most active part.

This substance called woorara, curare, corare, tiennas, has been variously described by different travellers as being of an animal or a vegetable nature, or a mixture of the two. Sir Walter Raleigh is said to have been the first who heard of its existence; but certain missionaries in South America gave at an early day an account of its effects, but so mingled with fanciful details as to deprive it of most of its value as authority.

At the commencement of the present century, Humboldt gave a detailed account of its manufacture, stating that it is prepared by heat from the bark of a certain vine called by the natives on the bank of the Amazon, *bejuco de menacure* mixed with the juice of certain other plants to give it consistence.

De le Condamine states that it is an extract made by heat from the juices of divers plants, about 30 in number, and that the bejuco is one of them.

Robert H. Schomburgk* confirms in most respects the account given by Humboldt. He named the vine from which it is obtained, *Strychnos toxifera.*

The Reverend Thomas Yond, who resided as a missionary in English Guiana, describes its mode of preparation very minutely. He states that two species of Strychnos and six other species of plants enter into its composition.

Mr. Schomburgk treats as entirely fabulous the accounts of the employment of animal substances, such as poisonous ants or the venom of serpents, in its preparation; and most English writers seem to consider it certain that it owes its activity to strychnine.

On the other hand Boussingault and Roulin, (Annales de Chimie, September, 1828,) who made an analysis of it, state that it does not contain strychnine but a vegetable principle very different from it.

Its effects on the system sufficiently indicate that its action does not

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* Annals and Magazine of Natural History, vol. VII, p. 407.

depend on strychnine. It affects the brain, producing fainting, insensibility, and paralysis; while strychnine acts upon the spinal marrow, producing convulsions but leaving the consciousness intact.

When injected into the veins, even in the minutest quantity, it kills in a few seconds, while a much larger quantity of strychnine is required to cause death when thus administered.

Mr. Charles Waterton, in his Wanderings in South America, states that in addition to the woorara vine, the natives employ in its composition the black and red ant and the fangs of serpents, which, he adds, they invariably extract and preserve whenever occasion is presented.

From a chemical analysis of this substance which I had made, though not completed, but which has revealed formic acid and a protean compound among its constituents, I am enabled to state with great certainty that animal substances enter to a certain extent at least into its composition.

Humboldt, in his voyage to the equinoctial regions of South America, states that Indians, who had been wounded by poisoned arrows, described to him the effects as identical with those of the bite of serpents.

These effects, as noticed in experiments on animals and birds, seem to me to bear the closest analogy with those of the venom of serpents, if they are not identical.

The fact that the woorara is, like the poison of serpents, innocuous when swallowed, strongly militates against the opinion that it is strychnine, or, indeed, any vegetable alkaloid. As usually met with, the kind which is brought from South America is contained in small gourds, over the internal surface of which it is spread. On being detached it presents a dark color, has a resinous fracture, a bitter taste, is readily mixed with water, but imperfectly dissolved by it. Its appearance is the same when mixed with alcohol; but both these fluids dissolve the active principle of it. The solution is acid. If the quantity of water used be small, the mixture has a ropy, tenacious consistence. The solution is coagulated by the nitrate of silver, and by the solution of iodine and iodide of potash in distilled water, and, when treated with the latter solution, neither the part coagulated nor the fluid expressed from it retains its poisonous quality. It does not effervesce with acids. Its aqueous solution is not coagulated by heat, and boiling does not impair its activity.

The manner in which poisonous substances act in producing their effects has long been regarded as one of the most difficult subjects in the wide range of nature. So long as the doctrines of astrology prevailed, they were supposed to derive their properties from the malign influence of the stars.

Ambroise Paré, certainly one of the most enlightened men of his time, was governed by the then prevailing doctrine when he said: "Poisons which act by a specific nature do not produce their effects because they are hot, or cold, or dry, or of an excessive humidity, but because they have that peculiar property of the celestial influences which is contrary to human nature."

In the infancy of toxicology the effect of nearly all poisons was referred to sympathy.

When they were applied to wounds, and the heart ceased to act, it

was said to be from a sympathetic affection, conveyed in some mysterious manner by the nerves.

The statement that any such impression is conveyed is as purely gratuitous as was the explanation of the pressure of the atmosphere by the simple expression, "nature abhors a vacuum."

Since the experiments of Magendie, in 1809, on the subject of absorption, it has generally been admitted that most poisons produce their effect on the system by being absorbed and carried into the circulation, and that they exert their influence by virtue of their peculiar properties.

Conia digitaline and nicotine destroy the action of the heart; strychnia acts upon the spinal marrow; opium, the woorara, and poison of serpents on the brain.

Now, although the absorption of poisons, and their presence physically in the blood and organs, is a most important fact,—one, indeed, upon which the whole science of toxicology reposes,—it is not to be imagined for a moment that it affords the slightest explanation of their mode of action.

The question still remains, whether they act by being applied to the sentient extremities of the nerves, or in some other manner not yet understood.

Liebig has offered the explanation, that the poison by some chemical change is converted into the substance of brain, which is thereby rendered unfit to support vital energy.

This hypothesis is entirely gratuitous, improbable, and, in view of the rapid action of many substances on the brain, impossible.

Fontana was much nearer the truth when about a century ago he attributed death from the poison of the viper to the effect produced on the blood. He was of the opinion that, injected into the veins of animals, it caused coagulation of the blood, which arrested the circulation. He made more than six thousand experiments with vipers, repeated and varied in every possible way. In regard to the coagulation of the blood in this case, I am not able to deny that it may occur, as I have not experimented with vipers; but I am sure it is the reverse of what takes place from the bite of the rattlesnake, for it is uniformly found dissolved after death from this cause, and incapable of coagulating to the same extent as in health. I am also certain that a change does occur in the form of the globules of blood in pigeons and frogs poisoned by woorara and the bite of the rattlesnake.

If the wing of a bat or the web of a frog's foot be subjected during life to observation beneath the focus of a microscope, innumerable small bodies are seen hurrying along the arteries, towards their extremities, traversing the small, hair-like vessels called capillaries, and returning towards the heart by the veins.

These bodies are the blood globules. They vary in form in different classes of animals, being circular and flattened in men, and ovoid in birds and frogs.

The integrity of these globules is essential to life; for whenever they become altered, they adhere to the sides of the vessels and to one another, and can no longer traverse the capillaries.

The theory that poisons alter the form of the globules, so as to render

them unfit for circulation, is not a new one, for Fontana alludes to it, but says he had not been able to detect in them any change.

This arose, no doubt, from the imperfect instruments employed, and from the deficient means of examination. Fontana claimed to have invented the microscope, but only used a single lens, and examined blood in considerable quantities.

By using the most perfect microscope, and examining the blood of frogs and of pigeons, in which the globules are ovoid and of large size, I have been able to discover that, after poisoning by serpent bite or the woorara, their form is constantly altered, so that, instead of being of a distinct and regular outline, they are found irregular, indented, and partially disintegrated.

Those taken from the capillaries are most, those from the heart and large vessels least affected; but even of the former only a small portion of the whole number will be found changed, as death takes place before all have time to become mutually affected.

When death occurs quickly from the effect of the bite of the rattlesnake or from the woorara, it is, in my view, from these substances being absorbed, and acting upon the blood by altering the form of the globules, so as to render them unfit for circulation, whereby they are arrested in the capillary vessels of the brain, and thus destroy its action.

There are doubtless other changes produced on the circulating fluid besides this of the globules.

The late Dr. J. W. Burnett, of Boston, noticed that when blood obtained by pricking his finger was mingled with the venom of the rattlesnake, the globules ceased to run together, as they naturally do.

But I think the change of the globules which I have detected is of itself quite sufficient to account for the sudden effects even of the most violent poisons.

The belief that some substances cause death by their effect upon the blood seems to have prevailed long before it was expressed by Fontana.

Shakspeare, with that intuitive perception of truth characteristic of his writings, has adopted it in his account of the killing of the king, when the ghost thus describes to Hamlet the effects of the poison:

> "Sleeping within mine orchard,
> My custom always in the afternoon,
> Upon my secure hour thy uncle stole,
> With juice of cursed hebanon in a vial,
> And in the porches of mine ears did pour
> The leperous distilment, whose effect
> Bears such an enmity to the blood of man
> That, swift as quicksilver, it courses through
> The natural gates and alleys of the body,
> And, with a sudden vigor, it doth posset
> And curd, like eager droppings into milk,
> The thin and wholesome blood; so did it mine,
> And a most instant tetter marked about,
> Most lazar like, with vile and loathsome crust,
> All my smooth body."

We arrive now at the consideration of the second part of our subject, the treatment of poisoning by serpent bite, and the woorara.

According to the division of scientific studies most commonly adopted, the pursuit of science for itself, pure science as it is called, ranks above any practical application of it, however important and useful this latter

may be, though I regard it important in proportion as it has capacities for useful application.

One might indeed devote himself to the pursuit of some of the natural sciences for the inherent pleasure which it affords.

But the study of the venom of serpents and its effects would be surrounded by few attractions, were it not that the knowledge thus acquired may be made available for the relief of some of the severest accidents to which man is subject.

The experiments upon birds and animals required to carry out these researches are painful, and can only be justified by the benefit which results from their performance.

In this country there is fortunately less occasion than in some others for defending the study of the practical applications of science, as the genius of the people, and their habits, tend to practical results rather than abstract researches. It is indeed possible that to many scientific men of our country the classic fable of Atalanta, who, in turning aside to seize the golden apple, lost the prize of the race, may not be inapplicable.

In reference to the venom of the rattlesnake there is much need that further investigations should be instituted.

It is a substance for which, as I have already said, no antidote has hitherto been known, and concerning the nature of which no adequate researches have ever been made.

What is required is a series of experiments in regard to it similar to those which Fontana performed with the viper.

The treatment resorted to for serpent bites varies in different countries, that remedy being generally selected which tradition or accident may have suggested; and it would be a waste of time to enumerate all those inert or deleterious articles whose use has been recommended even in books of medicine and surgery. It may suffice to say, under this head, that scarcely any substance can be named so inert as not to have been recommended, or so disgusting as not to have been employed; nor is any practice so absurd as not to have found favor with the profession.

Among them may be mentioned burying the member bitten in fresh earth, thrusting it into the entrails of animals, or even putting the whole body of the patient into an ox laid open for the purpose—practices which, as they are either cooling or sweating, are not destitute of plausible reasons in their favor.

Arsenic, in the form of the Tanjore pill, has been extensively used by British practitioners both in the East and West Indies; but although many successful cases were cited in its favor, it has fallen into disuse.

Among intelligent physicians of the present day the treatment consists in washing the part, sucking it, or applying cups, to extract the poison, using caustic for the purpose of destroying it, while stimulants, such as ammonia and alcohol, are administered internally.

Of these means, washing, applying ligatures upon the members, and cupping, are those alone whose utility has been well established by reason and experience.

That the removal of as much as possible of the venom from the wound is useful, is self-evident, and sucking it for this purpose seems

to have been an instinctive act; for not only does tradition relate that it was in use in ancient times and among savage nations, but history informs us that it has been resorted to more recently. Among the notable instances of which may be mentioned that of Queen Eleanor, wife of Edward I, who, it is stated, sucked the wound which her husband received from a poisoned dagger in the war of the Crusades, thereby preserving his life.

The application of ligatures around a member bitten, as it retards absorption, has the same effect as introducing the poison in divided doses, and at longer intervals of time. In this way quantities might safely be received, which, if carried at once into the blood, would prove quickly fatal.

Cupping-glasses exhausted over the wound act in the same manner, with the additional advantage, that by drawing fluids from the part they may remove at least a portion of the venom.

The value of these means has been tested by numerous experiments upon various animals and with different classes of poisons.

Of the applications resorted to, aqua ammonia is that mostly relied upon. But Fontana found that mixing it with the venom of vipers only hastened death. He also found that alcohol, oil, the mineral acids, and alkalies, (except caustic potash, which instantly destroys the tissues,) nitrate of silver, incisions in the part, and even amputating the member bitten, did not prevent a fatal termination.

In my experiments with the rattlesnake I have found that mixing the venom with alcohol, oil of turpentine, nitrate of silver in solution, or ammonia, did not diminish its activity.

The solutions of soda and potash have no effect in retarding its action, unless sufficiently strong to destroy the tissues by acting as a caustic.

My friend, Dr. J. C. Morfit, who aided me in my experiments, tried liquor potassæ, a solution of bicarb. of soda, tincture of arnica, and ammonia in water. The result of my observation is, that to the present time no substance has been found in any degree capable of neutralizing the venom of the serpent or the woorara, without destroying the part bitten, except the solution of iodine, and iodide of potassium, in water. Of the virtues of this solution I shall have occasion to speak hereafter.

Alcohol taken internally to intoxication has at the present time the reputation of counteracting the effects of the venom of the rattlesnake.

The evidence in its favor is scarcely sufficient to justify the confidence reposed in it, as the following facts will show:

1st. The venom, when mixed with alcohol, is rapidly fatal if inoculated.

2d. Alcohol introduced into the stomach of birds or animals bitten hastens death.

3d. Persons bitten by rattlesnakes when in a state of intoxication are not, on that account, secure.

I have authentic information of several cases in which the bite of that serpent proved rapidly fatal on intoxicated persons. I think it certain, however, that the effect of alcohol taken in this way is beneficial rather than injurious; but this is not my belief in regard to ammonia, which I think calculated to favor the action of the poison rather than retard it.

Among the substances in popular use in the western States of the Union, I ought not to omit to speak of the sulphate of alumina or alum. This and other astringents are principally useful in that stage of the affection when hemorrhages are liable to occur, and they may then be employed with advantage both as internal remedies and local applications.

It may be expected that I should here speak of those plants which, under the name of rattlesnake weeds or roots, possess, in the popular belief, a specific virtue against the bite of this serpent. The plant known under this name in many parts of the west is a species of *Liatris*, having a broad leaf with spines along the edges. It has a pungent aromatic taste, and is a diffusible stimulant of moderate force. The manner in which it is generally used is by beating it up into a poultice and placing it upon the part, and also taking an infusion as a drink. It has no specific virtues as an antidote, as I have known deaths to occur after its use; but as a stimulant it may be, in some degree, useful.

There are many other plants, also, reputed to possess similar virtues, among which may be mentioned *Eryngium aquaticum*, or button-snake root; several species of *Impatiens*, or jewel weed; the *Eupatorium perfoliatum*, or boneset; the *Scrophularia*, the *Scutellaria*, the *Plantago*, and probably many others; of all of which it is sufficient to say, that there is no conclusive evidence to justify their being regarded in the light of specifics, though, like the *Liatris*, they may be more or less useful in certain cases.

As remedies are by some deemed important from having been used by the Indians, it may be mentioned that the *Impatiens*, or jewel weed, is said to be often employed by them. A medical officer of the army informs me that the common nettle applied as a poultice, and taken in infusion, is a favorite treatment among the Cherokees. For this, as for hydrophobia and most diseases, there are secret remedies, possessing, according to report, the most instantaneous and marvellous power of neutralizing the action of the poison.

There exists, according to popular belief, a tree whose smallest branch or leaf has the effect if placed before a serpent of rendering him so timid and fearful that he will neither bite nor resent the roughest treatment, nor can he live in the region where it grows. The leaves possess the power (according to the same vague report) when beaten up and placed on the bitten part of instantly causing the pain to cease; so that the patient, like one touched by a hand of miraculous power, is straightway cured. The tree which is reported to possess such virtue is nothing else than a species of *Fraxinus*, or common ash. It is certain that it has none of the powers ascribed to it, either on the actions of the serpent or the effects of its venom.

Having made many experiments, with a view of determining the action of various substances on the venom of the rattlesnake and on the woorara, I have found but one which, in any degree, neutralizes it without destroying the tissues of the part.

The solution of iodine and iodide of potassium in water possesses the power, when properly used, of invariably retarding death, if it does not prevent it. The manner in which the experiments were conducted

with the woorara, was, in the first place, to ascertain the quantity required to cause death.

In general I found $\frac{1}{5}$ of a grain to kill a pigeon in five minutes, when injected under the skin.

2. I then mixed the same quantity with 20 drops of a solution of iodine and iodide of potassium, of the strength of 10 grains of the former and 30 of the latter to the ounce of distilled water, and injected it under the skin of the pigeon. It produced no sensible effect.

3. I threw the poison under the skin of the pigeon, and applying a cupping glass lightly on the part, injected the solution of iodine through the same canula. No symptom of poisoning followed.

4. I covered a deep wound of the muscle in a pigeon with a paste made of the woorara and water. The bird died in five minutes.

5. I repeated the same experiment, but washed the wound with the solution of iodine. There was no bad effect.

These experiments have been repeated by myself alone, and, in connexion with others, more than a hundred times with the same results. I feel confident, therefore, that their accuracy cannot be called in question, and that, in regard to the woorara, it is quite safe to affirm that the solution of iodine neutralizes its action. In making this statement, I would by no means be understood as asserting that it does so in all circumstances and in all proportions. The circumstances which prevent its doing so are the introduction of the poison in such a situation that the solution cannot reach it, or so directly into the circulation that it has not time to act upon it. In most cases of wound neither of these conditions is likely to occur.

According to the experiments which I have made for the purpose of determining the proportion of iodine required to neutralize the poison, it appears that one third of a grain of woorara is perfectly neutralized by one eighth of a grain of iodine.

The treatment of the bite of the serpent is more difficult to determine by experiment than that of the wounds poisoned by woorara. The bite itself is often profound, penetrating so deeply that applications cannot be made to the bottom of it without inflicting an additional injury, which, in itself, would be dangerous to small animals. On the other hand, if the venom be first extracted from the serpent, and then inoculated, its action is uncertain. Much of what appears to be venom is, probably, only saliva, which serves as a vehicle, and is with difficulty distinguished from it. Nevertheless, I have succeeded in saving more than half the birds bitten, and in greatly prolonging life in those which died.

The manner in which these experiments are conducted is as follows: The bite having been inflicted on a given part, by having the serpent properly confined, immediately apply a cupping glass lightly upon the point, then insert a fine trochar beneath the cupping glass, under the skin, and, while the air is being exhausted, press the solution of iodine into the tissues of the part with a small syringe adapted to the canula of the trochar. The cupping glass is retained upon the wound until the solution has had time to disseminate itself, and become mixed with the poison.

In case of a superficial wound, when the treatment could be applied

immediately, nothing more would be required than to wash it with the solution.

As pigeons, upon which these experiments were made, are more easily affected than mammals, the antidote which succeeds with them more certainly succeeds in case of the bite on man.

The principle on which the iodine operates in counteracting the effect of these poisons, is most probably from its antiseptic properties.

They belong to a class described by Orfila under the name of putrefactive poisons, characterized by being innocuous, or of little activity, when swallowed, but causing wounds upon which they are applied to run rapidly into mortification.

Iodine, like chlorine, has the effect of counteracting this change; preventing the discoloration which results from such wounds, and the alteration of the blood to which they give rise, while it possesses over chlorine the additional advantage of not causing inflammation or mortification, when injected under the skin and disseminated in the tissues.

The practice of injecting it into the parts, instead of applying it upon the surface, is founded upon the principle, now well established in toxicology, that an antidote, to be effectual, must not only be introduced into the system, but brought in contact with the poison where it physically exists.

Now for all inoculated poisons it is clear that to comply with this condition the antidote must also be inoculated; that is, introduced into the same tissues, and take its course through the same vessels which the poison has to traverse, to reach the vital organs.

When the poison is inoculated and the antidote swallowed, or applied on the surface, it is impossible that they could be brought in contact in more than the minutest proportions.

Used in this way, the iodine also favors the production of adhesive inflammation, whereby lymph is effused and coagulated around the wound, absorption retarded, and the disease rendered less diffusive. In this respect iodine, injected under the skin, is more efficient than blisters or cauterization with the nitrate of silver, which can only act superficially.

Although I have advanced the theory that iodine is an antidote to septic poisons, by virtue of its anti-putrescent properties, I would not, by any means, be understood as limiting its effects to this method of action. On the contrary, I believe it is, to a certain extent, an antidote for some poisons pertaining to other classes.

Donné found it to counteract the action of strychnia to a great degree; and I have observed that it has a very considerable power as an antidote to prussic acid, an action which its analogy to chlorine would lead us to expect, as chlorine is well known to prevent the effects of this acid.

The plan of treatment which I recommend for the bite of serpents and wounds from poisoned arrows, is—

1st. To wash the part with a solution of iodine and iodide of potassium, and apply cupping-glasses over the wound, or ligatures around the member, so as to prevent absorption.

2d. If the wound be deep, or if absorption has already taken place,

I recommend injecting the solution under the skin, beneath the cupping-glass, and disseminating it by friction about the wound.

This recommendation is founded upon the result of over one hundred experiments with the woorara, and about sixty with the rattlesnake, made upon pigeons, dogs, cats, rabbits, and guinea-pigs.

This treatment can be combined with the administration, internally, of such remedies as may be thought most useful; and among these alcohol, in some form, taken freely is, in the present state of our knowledge, to be preferred.

LECTURES.

No. III.—THE ZONE OF SMALL PLANETS BETWEEN MARS AND JUPITER.

BY PROFESSOR ELIAS LOOMIS, OF THE UNIVERSITY OF NEW YORK.

Seventy-five years since, the only planets known to men of science were the same which were known to the Chaldean shepherds thousands of years ago. Between the orbit of Mars and that of Jupiter there occurs an interval of no less than three hundred and fifty millions of miles, in which no planet was known to exist before the commencement of the present century. Nearly three centuries ago the immortal Kepler had pointed out something like a regular progression in the distance of the planets as far as Mars, which was broken in the case of Jupiter. Being unable to reconcile the actual state of the planetary system with any theory he could form respecting it, he hazarded the conjecture that a planet really existed between the orbits of Mars and Jupiter, and that its smallness alone prevented it from being visible to astronomers. But Kepler himself soon rejected this idea as improbable, and it does not appear to have received any favor from the astronomers of that time.

An astronomer of Florence, by the name of Sizzi, took decided ground against all such innovations of doctrine. He maintained that since there are only seven apertures in the head—two eyes, two ears, two nostrils, and one mouth—and since there are only seven metals, and seven days in the weeks, so there can be only seven planets. These seven planets, according to the ancient systems of astronomy, were Saturn, Jupiter, Mars, the Sun, Venus, Mercury, and the Moon.

In 1772, Professor Bode, of Berlin, first announced the singular relation between the distances of the planets from the sun, which has since been distinguished by the name of Bode's law. This law exhibited in a striking light the abrupt leap from Mars to Jupiter, and suggested the probability of a planet revolving in the intermediate region. This conjecture was rendered still more plausible by the discovery in 1781 of the planet Uranus, whose distance from the sun was found to conform nearly with the law of Bode. In Germany, especially, a strong impression had been produced that a planet really existed between Mars and Jupiter, and the Baron de Zach went so far as to compute the orbit of the ideal planet, the elements of which he published in the Berlin Almanac. In the year 1800, several astronomers, of whom the Baron was one, formed an association, whose object was to effect the discovery of the unseen body. For this purpose the zodiac was divided into twenty-four zones, one of which was to be explored by each astronomer. Soon after the formation of this society the planet was discovered, but not by any of those astronomers who were engaged expressly in searching for it. Piazzi, the celebrated Italian astronomer,

while engaged in constructing his great catalogue of stars, was induced carefully to examine, several nights in succession, a part of the constellation Taurus, in which Wollaston, by mistake, had assigned the position of a star which did not really exist. On the first of January, 1801, Piazzi observed a small star which, on the following evening, appeared to have changed its place. On the third, he repeated his observations, and he now felt assured that the star had a retrograde motion in the zodiac. He continued to observe the star until the 11th of February, when he was seized with an illness which interrupted his labors. After the planet had approached too near the sun to admit of further observations for that season, Piazzi communicated to astronomers all his observations. Professor Gauss found that they might all be satisfied by an elliptic orbit, of which he computed the elements. The planet was re-discovered on the 31st of December, almost exactly in the place which had been predicted by Gauss; and it received the name of Ceres.

The distance of Ceres from the sun was found to be almost exactly the same as had been assigned by Bode's law. In this respect, therefore, the newly discovered planet harmonized with the other bodies of the system to which it belonged. The new planet was, however, excessively minute, its diameter, according to Herschel's measurements, amounting to only one hundred and sixty-one miles.

The discovery of this planet was soon followed by another of a similar nature. Dr. Olbers, while engaged in searching for Ceres, had carefully studied the positions of all the small stars lying near her path. On the 28th of March, 1802, after observing Ceres, he swept over the vicinity with an instrument termed a "comet seeker," and was astonished to find a star of the seventh magnitude in a position where he was sure no star had been visible the preceding month. In less than three hours, he found that its place had changed. On the following evening he looked again for his star, and found that its motion was unquestionable. The elements of its orbit were soon determined by Professor Gauss, who found that its distance from the sun was nearly the same as that of Ceres; and it received the name of Pallas.

A comparison of the relative magnitudes of the planetary orbits had suggested the existence of an unknown planet revolving between Mars and Jupiter. Instead of one planet, however, two had been discovered. Olbers remarked that there was a point where the orbits of these two bodies approached very near each other; and he conjectured that they might possibly be the fragments of a larger planet, which had been split in pieces by some tremendous catastrophe; and he intimated that there might be many more fragments which had not yet been discovered. He also inferred that, according to this theory, the orbits of all the fragments would have two common points of intersection situated in opposite parts of the heavens, through which every fragment must pass in the course of each revolution. He therefore proposed every month to search carefully the two points of the heavens in which the orbits of Ceres and Pallas were found to intersect each other. The speedy discovery of a third planet tended to confirm the truth of this hypothesis.

On the 1st of September, 1804, Professor Harding discovered a small

star very near the place where Olbers had asserted that the fragments of the shattered planet must all pass. On the evening of the fourth he found that the star had changed its place. This planet was named Juno. Its orbit was computed by Gauss, who found its distance from the sun to coincide nearly with those of Ceres and Pallas.

Stimulated by this new discovery, Olbers continued with unwearied assiduity to explore the two regions of the heavens already referred to, and, after three years of laborious search, his perseverance was crowned with success. On the 29th of March, 1807, he discovered a small star in a place where none had been found in his previous examinations. He soon satisfied himself that this object was a planet; and it received the name of Vesta. The elements of the orbit were determined by Gauss, who found its distance from the sun to be a little less than that of Ceres, Pallas, or Juno.

Dr. Olbers continued his systematic examination of the heavens until 1816, but was rewarded by no further planetary discoveries.

In 1825, a fresh impulse was given to researches of this nature by the resolution of the Berlin Academy, to procure the construction of a series of charts showing the position of all stars down to the ninth magnitude situated within fifteen degrees of the equator. Only about two thirds of the charts contemplated in this great undertaking have yet been executed.

After the discovery of Vesta, succeeded a long interval of thirty-eight years, during which the excitement created by these first discoveries subsided, and the search for new planets was generally abandoned.

At length, in 1845, a fifth asteroid was announced by an observer hitherto unknown to fame, Hencke, of Germany. In 1847, the same observer announced a sixth asteroid, and from this time numerous observers in every part of Europe devoted much of their time, while some devoted nearly all of their energies to the search for planetary bodies; and discoveries at once multiplied with astonishing rapidity. Three new asteroids were discovered in 1847, one in 1848, one in 1849, three in 1850, two in 1851, eight in 1852, four in 1853, and six have been announced during the year 1854, making at the present time a total of thirty-three. Of these thirty-three ten were first discovered by Mr. Hind, of London; seven by Dr. Gasparis, of Naples; three by Luther, of Bilk; while Dr. Olbers, of Bremen, Hencke, of Driesen, Chacornac, of Paris, and Goldsmith, also of Paris, have each of them discovered two asteroids; and Piazzi, Harding, Graham, Marth, and finally Ferguson, of our own National Observatory, have each discovered one. Moreover, in several instances, the same planet has been independently discovered by more than one astronomer.

In scarcely a single instance could these discoveries be termed the result of accident. They have been the result of a laborious search expressly undertaken for the discovery of these bodies. Mr. Hind, who has been the most successful explorer in this field, nearly ten years ago commenced comparing the Berlin charts with the heavens, and began to map down for himself the stars in other regions of the ecliptic, which did not fall within the limits of the Berlin charts. Any discrepancy between the stars on the maps and the stars in the heavens was carefully scrutinized; so that if a new star presumed to show itself within

the limits of the charts, it was at once pounced upon as an unlicensed wanderer.

The discoveries of Gasparis were also made partly by comparing the Berlin maps with the heavens, and partly by a series of observations in zones of declination, made for the express purpose of finding new planets. Nearly all the asteroids have been discovered by a systematic comparison of the visible state of the heavens, with the state as recorded in charts.

The rapid discovery of twenty-nine new asteroids, after a barren interval of almost forty years from the discovery of Vesta, is calculated to excite surprise; but it is explained by the diminutive size of the new planets, and the great increase in the number of observers, as well as the use of more powerful instruments. Vesta appears like a star of the sixth magnitude, Pallas of the seventh, while Ceres and Juno are of the eighth. Of the twenty-nine asteroids more recently discovered, none of them, with perhaps two exceptions, are larger than the ninth magnitude, while several are as small as the tenth, and one or two scarcely, if ever, rise so high as the tenth magnitude. The reason that Olbers was not more successful in his search was that he employed a telescope of too feeble power, and did not extend his examination beyond stars of the eighth magnitude.

Some may conclude that the number of asteroids already known is so great that the discovery of additional ones is a matter of no interest, and is unworthy the attention of astronomers. I regard the question in a very different light. If only one planet had hitherto been discovered between Mars and Jupiter, our idea of the simplicity and perfection of the solar system would have been satisfied; and there might have been found ingenious minds attempting to prove by a priori reasoning, that no other planets could possibly exist, unless beyond the limits of the orbit of Neptune. But our theory of the solar system, although apparently simple, would not have been the *true* theory. Every new discovery shows the solar system to be more complex than we had supposed; and unless we prefer error (provided it has a show of simplicity) to truth, when it appears to our view complex, we shall value every new discovery in the solar system, because it promises to conduct us nearer to the true theory of the universe. Every new asteroid which is discovered is a new fact to be explained. It presents a new test by which every theory is to be tried. The true philosopher, instead of regarding the rapidly increasing number of asteroids with indifference, will watch each new discovery with growing interest, in the hope that it may furnish the key to the true theory of the solar system.

The existence of thirty-three planets revolving round the sun, at distances closely allied to each other, and differing from all the other planets in their diminutive size, is one of the most singular phenomena in our solar system. This fact will appear the more striking if we draw a diagram representing the orbits of all the known planets in their proper proportions. We shall find that while the orbits of Mercury, Venus, the earth, and Mars are quite detached from each other, and the orbits of Jupiter, Saturn, Uranus, and Neptune are separated by intervals which the imagination can scarcely grasp; between Mars

and Jupiter is a cluster of bodies whose orbits are so interlaced as to suggest the apprehension of frequent and inevitable collision. The orbit of Fortuna approaches the orbit of Metis within less than the moon's distance from the earth, while the orbit of Massilia approaches almost equally near to the orbit of Astræa, and the orbit of Lutetia to that of Juno.

It is evident then that these thirty-three small planets sustain to each other a relation different from that of the other members of the solar system. We see a family likeness running through the entire group; and it naturally suggests the idea of a common origin. This idea, as has been already stated, occurred to the mind of Olbers after the discovery of the second asteroid, and led to his celebrated theory, that all these bodies originally constituted a single planet, which had been broken into fragments by the operation of some internal force. Have we any means of testing the soundness of this theory?

If the earth should be broken into fragments by the operation of some internal force, (such for example as that which causes the eruption of a volcano,) the fragments might be projected in various directions, and with very unequal velocities, but each would describe an ellipse, of which the sun would occupy one of the foci; if we except the extreme but possible case of a fragment projected with such a velocity as to carry it beyond the limit of the sun's attraction. If we leave out of view the disturbance arising from the mutual attraction of the planets, which produces only minute effects, each fragment would continue to describe the same ellipse in its successive revolutions about the sun; in other words, these ellipses *would all have a common point of intersection.* The same conclusion must hold true for the asteroids, according to the theory of Olbers. The question, of course, arises, have the orbits of the asteroids a common point of intersection? A single glance at a diagram of these orbits will settle this question in the negative. But it is replied that the orbits of the planets are disturbed by their mutual attraction: these orbits should *originally* have had a common point of intersection; but at each revolution they suffer a slight displacement, until in the lapse of time the position of the orbits has become so completely changed as to leave scarcely a trace of their original intersection. Is such a result possible? A few simple considerations will satisfy us that if the orbits of the asteroids ever had a common point of intersection, such a result must have belonged to a period of time indefinitely remote.

The line in which the plane of a planet's orbit intersects some other plane, selected for common reference, is called technically the line of the *nodes.* If the asteroid orbits ever had a common point of intersection, all the nodal lines upon one of the orbits must have coincided. Now, as two of the asteroid orbits are inclined less than one degree to the earth's orbit, we will, for greater convenience, employ the latter as the plane of reference. On referring to a table of the planetary elements, we see that the ascending nodes of the asteroids are distributed, though unequally, through the four quadrants of the circle. Ten of them lie in the first quadrant, twelve in the second quadrant, seven in the third, and four in the fourth. The nodes of all the planetary orbits are in constant motion; but the motion for a single

year is extremely small. The annual motion of the node of Mercury is ten seconds; that of Venus is twenty seconds; Mars twenty-five seconds, &c. The most rapid motion found in the nodes of any of the asteroid orbits, as far as the computation has been made, is about fifty seconds a year. If we suppose the nodal lines of all these orbits to move steadily toward each other, it would require, in some of them, a motion of fifty seconds a year, continued for more than six thousand years, to bring them to a coincidence.

It must also be observed, that not only must the nodes of all the asteroids coincide, but the distance of the planets from the sun must be the same at that instant. Now, the distances of these bodies from the sun, when at their nodes, differ by more than a hundred millions of miles; so that, to bring them all together, requires something more than a change in the position of the nodes. We may bring about a coincidence in the case of some of the asteroids, by supposing the longer diameter of the elliptic orbit to change its position, without disturbing the plane of the orbit. Such a change does really take place in the case of every planetary orbit, but with none of the larger planets does it exceed twenty seconds a year. In the case of one of the asteroid orbits, this motion has been found to amount to seventy seconds a year; but, even with this motion, it would require the lapse of five thousand years to bring about an intersection in the case of many of the asteroid orbits. When, now, it is remembered that, in order to give a common point of intersection to these thirty-one orbits, all the nodal lines must coincide, and, at the same instant, all the distances from the sun must be equal to each other, we must be prepared to admit that such an occurrence could only have taken place myriads of years ago.

The preceding difficulties, however, are small, in comparison with another which remains to be stated. The orbit of Hygeia completely encloses the orbit of Flora, and, indeed, several other orbits, and would still enclose them, although the greater diameter of each of them were revolved through an entire circumference—since the least distance of Hygeia from the sun exceeds the greatest distance of Flora. The same is true of Themis, as compared with Flora, and several other orbits. The least distance of Hygeia from the sun exceeds the greatest distance of Flora by more than *twenty-five millions of miles*. In order to render an intersection of these orbits possible, we must suppose a great variation of the eccentricity. But the change of eccentricity of the planetary orbits is exceedingly slow, and the present rate of increase of the eccentricity of Vesta must be continued *twenty-seven thousand years*, to render the aphelion distance of that planet equal to the perihelion distance of Hygeia. Moreover, the eccentricity of the orbit of Vesta is now *increasing*, which implies that in past ages the interval between Vesta and Hygeia must have been greater than it is at present; whence the conclusion appears irresistible, that the orbits of Vesta and Hygeia cannot have intersected for *several myriads of years*. When the secular variations of the elements of each of the asteroids have been computed, astronomers will be able to assign a limit of time, beyond which the intersection of all the asteroid orbits must have occurred, if, indeed, such an intersection ever took place. The discovery of many of these bodies is so recent that, as yet, there has not been sufficient

time for such a computation; but, from what we already know, we hazard little in venturing the opinion, that when this computation shall be made, it will appear that, if the asteroid planets ever composed a single body which exploded, as Olbers supposed, such explosion must have occurred *myriads of years ago*. Indeed, the discovery of such a host of asteroids seems to have stripped the theory of Olbers of nearly all the plausibility it possessed when it was originally proposed; and it would seem hardly less reasonable to suppose that the earth and Venus originally constituted but one body, than to admit the same for the thirty-three asteroids.

But, if we reject the theory of Olbers, what do we conclude? That the asteroids bear no special relationship to each other? Do they not all clearly indicate a family resemblance? And, if so, how do we account for this relationship?

There are several reasons for believing in some peculiar relationship between the asteroids.

1. Unlike the other planets of our system, they are all of diminutive size—the largest of them hardly exceeding one or two hundred miles in diameter. M. Leverrier, after a close examination of the nature and amount of the influences exerted by the entire group of asteroids upon the planets Mars and the earth, has arrived at the conclusion that the sum total of the matter constituting the small planets between Mars and Jupiter, including undiscovered as well as known asteroids, *cannot exceed about one fourth of the mass of the earth.*

2. The asteroids, in their position, occupy a zone entirely distinct from the other planets of the solar system. Between the orbits of Jupiter and Saturn, as well as between Saturn and Uranus, is an immense interval, furnishing space enough for a host of little bodies to circulate around the sun; but in not a solitary instance has any such body been found, except between Mars and Jupiter. Some may attempt to account for this circumstance, by saying that astronomers have long been watching exclusively this portion of space, and have left all other regions entirely unexplored. An exploration conducted upon such a principle is simply a physical impossibility. If there were a small planet between the earth and Mars, it would have stood the same chance of detection, in the explorations of the past ten years, as if it were situated between Mars and Jupiter; and, indeed, it would have stood a better chance of detection, inasmuch as it would appear of greater brightness on account of its proximity to us. If there were a small planet circulating between Jupiter and Saturn, it would have stood the same chance of detection as if it had been placed this side of Jupiter, except that it would appear somewhat fainter on account of its increased distance. The fact that we have discovered thirty-three small planets between Mars and Jupiter, and not a solitary one in any other portion of the solar system, points to something *special* in this region of the heavens. In other words, we have discovered *a limited zone* of little planetary bodies, and have not been able to discover a single body of the same class situated out of this zone.

3. The orbits of these little bodies present some special peculiarities.

The ascending nodes of the orbits are not distributed uniformly through the zodiac. The ascending nodes of twenty-two orbits are

included within the space of 180 degrees; while only eleven are left for the remaining 180 degrees of the zodiac. A similar remark applies to the position of the perihelia. In the first half of the zodiac we find twenty-five perihelia, while only eight remain for the other half of the circumference. We could not have anticipated any such bias in the orbits if they had always been entirely independent of each other.

4. But the most striking peculiarity of these orbits is, that they all lock into one another like the links of a chain, so that if the orbits are supposed to be represented materially as hoops, they all hang together as one system. The orbits of Hygeia and Themis being the largest of all the orbits, completely enclose nearly all of them, and lock into but a small number; while the orbits of Massilia, Astræa, Pallas, &c., lock into nearly all of the orbits, so that if we take hold of the orbit of Hygeia, which we fancy to be a material hoop, it will support the orbits of Iris, Thalia, Calliope, and two or three others, while these in turn lock into and support all the rest. Indeed, if we seize hold of any orbit at random, it will drag all the other orbits along with it. This feature, by itself, sufficiently distinguishes the asteroid orbits from all the other orbits of the solar system.

If we reject the theory that these asteroids were originally united in one solid body, it seems, nevertheless, difficult to avoid the conclusion that similar causes have operated in determining the orbits of this zone of planets. It is impossible to assign any cause for these resemblances without adopting some theory respecting the origin of the solar system. The theory of gradual condensation, as developed by Laplace in the nebular hypothesis, affords at least a plausible explanation of these phenomena.

Laplace supposes that the matter composing the bodies of our solar system, originally existed in the condition of an immense nebula, extending beyond the limits of the most distant planet—that this nebulous mass had an exceedingly elevated temperature, and a slow rotation on its axis—that the nebula gradually cooled; and as it contracted in dimensions, its velocity of rotation, according to the principles of mechanics, increased, until the centrifugal force arising from the rotation, became equal to the attraction of the central mass for the exterior zone, when this zone necessarily became detached from the central mass. As the central mass continued to contract in its dimensions, and its velocity of rotation continued to increase, the centrifugal force again became equal to the attraction of the central mass for the exterior zone, and a second zone was detached. Thus a number of zones of nebulous matter were successively detached until, by gradual condensation, the central mass became of comparatively small dimensions and great density.

The zones thus successively detached would form concentric rings of vapor, all revolving in the same direction round the sun. If the particles of each ring continued to condense without separating from each other, they would ultimately form a liquid or a solid ring. But generally each ring of vapor would break up into separate masses, revolving about the sun with velocities slightly different from each other. These masses would assume a spheroidal form: that is, they

would form planets in the state of vapor. If one of these masses were large enough to attract each of the others in succession to itself, the ring of vapor would be converted into a single spheroidal mass of vapor, and we should have a single planet of great mass for each zone of vapor detached. But if no one of these masses had a preponderating size, they would all continue to revolve about the sun in independent orbits, and would form a zone of little planets such as we have actually discovered between Mars and Jupiter.

With regard to the actual number of bodies belonging to this zone of planets, we can do little more than hazard a plausible conjecture. Already we have one asteroid of the sixth magnitude, one of the seventh, four of the eighth, eighteen of the ninth, and nine of the tenth or eleventh. It would require four hundred bodies as large as the largest of the asteroids, to make a body one fourth of the size of the earth; and, according to Leverrier, the sum of all the asteroids cannot exceed this limit. When we consider the shortness of the period during which stars below the eighth magnitude have been systematically observed, we see room for the discovery of several more planets of the ninth magnitude, and perhaps three or four hundred more of inferior dimensions.

With such a wonderful field of probable discovery inviting the explorations of astronomers, may we not hope that the enterprize of America will claim its share of the labor of this research? The rapid progress which the last few years have witnessed in our country, both in the facilities for observation, and in the number of active observers, is one of the most encouraging signs of the times. It is scarcely a quarter of a century since the first telescope, exceeding those of a portable size, was imported into the United States; and the introduction of meridional instruments of the large class is of still more recent date. Now we have one telescope which acknowledges no superior; and we have several which would be esteemed worthy of a place in the finest observatories of Europe. We have also numerous meridional instruments of dimensions adequate to be employed in original research. These instruments have not been permitted to remain unemployed. At the Observatory in this city, and also at Cambridge, extensive catalogues of stars are now in progress; while nearly every known member of our solar system has been repeatedly and carefully observed. These observations are all permanently recorded by a simple touch of the finger upon a key which closes an electric circuit—a method recently introduced at Greenwich Observatory, and known everywhere throughout Europe by the distinctive name of the American method.

Numerous, important, and striking discoveries have been the result of this astronomical activity. A host of comets have been independently discovered on this side of the Atlantic; and among them three, at least, were observed here before they were seen in Europe. The two nebulæ which have been longest and best known, and which have attracted the wondering gaze of every astronomer since the invention of the telescope, were never adequately figured until an American eye saw them, and an American pencil depicted them. The planet Saturn, which, for many years, was made the subject of special study by the elder Herschel, with his wonderful means of observation, first

revealed to American scrutiny a new ring, and an eighth satellite. The novel spectacle of a comet divided into two nearly equal portions was first witnessed by American eyes; and an American observer has added one to the long list of planetary discoveries.

It is gratifying to reflect that while the great powers of Europe are contending in mortal strife, and misery marks the progress of their arms, the astronomers of England are allies not only to the astronomers of France, but to those of America, of Germany, and of Russia also. The triumphs of science are bloodless and do not endanger the peace of nations. Let the New World contend with the Old in a generous emulation—not for the conquest of disputed principalities or fortified cities—but for a holier and a nobler conquest—the conquest of the skies.

LECTURE III.

THE AMERICAN FIRE-ALARM TELEGRAPH.

BY WILLIAM F. CHANNING, M. D., OF BOSTON, MASSACHUSETTS.

There are few positions more imposing than to stand at the capital of a country like our own, made up of confederated States, each State made up of confederated counties, each county perhaps made up of confederated townships; every part, from the least to the greatest, conspiring to form an organized whole—one nation, one people. From such a centre it is natural to look abroad over the fair land, at territories and commonwealths, at cities and hamlets, whose interests and national life are thus interwoven into one, and to ask what are the laws and what the means of organization by which civilization attains these her great ends? It is natural, from such a point of view, to inquire into the general laws of relation by which parts are intelligently bound together to form a composite whole for some end of use or beauty, that is, the laws of relation by which every organization, every mechanism, in the high sense of that word, is formed. The material universe, with its majestic movements of suns, stars, planets, light, heat, winds, tides, seasons, is such a mechanism, actuated ever by the infinite Power, shaped and guided by the infinite Wisdom, animated by the infinite Love. The power which went forth at creation established the universe, with all its beauty and capacity, by the intelligent combination of outward parts. By the marriage of elementary atoms, by the joining of lesser unities to form greater, in accordance with a principle of absolute order and harmony, nature took her perfect form. With this type of creation ever before us, the manifestation of God in his works, let not the word mechanism, if it effects only the humblest organization of material elements, appear to us low or unworthy. Whoever, in practical science, attains a result of human use, by the intelligent combination of outward parts, emulates, in his degree, the creative wisdom, which, in the language of an apocryphal writer, hath made all things by number, measure, and weight.

In the organization of states and municipalities, the object or end in view, the formative principle, is some ideal of human life and society, some thought or aspiration for freedom, justice, brotherhood; but the embodiment of these is an outward frame-work of civilization, the highest mechanism to which human thought and human hands have ever been applied, requiring the perfect relation of parts, and methods of communication and intercourse arranged and governed by an absolute law of order. It is here that Science becomes the great instrument of Civilization.

In the early history of this country, the thirteen colonies stretched along the sea-coast, and commerce joined their interests and established a common circulation between them. The sailing vessel—the clipper-schooner—then measured the possible rate of intercourse and capacity

of co-operation between those States. A languid life existed; a weak Confederacy in the outset was formed, proportioned to their outward means of communication and organization. A few centuries earlier than this, before navigation and other arts of locomotion had made much progress, each settlement on the coast would have been the centre of a small jurisdiction, with still less power of co-operation or union with its neighbors; science would have slept; events would have been slow; the human mind, for the most part, stagnant; civilization in abeyance; man isolated in industry and social sympathy from his fellow man.

At the time of the formation of the American Constitution our fathers looked with anxiety at what seemed to them an immense territory, though now but a small fraction of this republic, and asked if veins and arteries could ever ramify through this body politic, and interfuse the whole system with a common life-blood. To increase the difficulty and danger, new territory was added, new States in the interior of the country came in; but, at the same time, the genius of civilization and the providence of God gave to us the realization of the dream of the poet in the invention of the steamboat. A new means of relating men to each other, of combining their industry, of introducing the era of peace and good will upon earth, was discovered. Wherever the great rivers penetrated the heart of the continent, there quick communication could be had with the centres of government, industry, and commerce throughout the land.

A few years later, and our population, with the instinct of freedom, spread still further over the prairies and into the wilderness. The nation was again outgrowing its means of intercommunication and common life, when the railroad and steam-car were invented, and again the continuance of the commonwealth became possible; the confederated republic had a new lease of life by virtue of the application of science to civilization.

Still later our empire spread to the Pacific and stretched three thousand miles across the American continent. Different oceans washed its two shores. Our faces on the Atlantic coast were turned eastward, our brothers on the Pacific looked westward, and the Rocky mountains rose between. By steamboat or railroad, weeks must now intervene in the communication between distant parts of this mighty organization of confederated municipalities and States. The veins and arteries were provided, but the living nation had yet no nervous system to flash communication from one part to another, and to combine the whole into an organized body, which might, in its capacity for future expansion, include the whole race, and inhabit the whole earth. Before this time of need had fully arrived, the electric telegraph received its most important development, and was introduced into America.

The electric telegraph is thus the nervous system of this nation and of modern society, by no figure of speech, by no distant analogy. Its wires spread like nerves over the surface of the land, interlinking distant parts, and making possible a perpetually higher co-operation among men, and higher social forms than have hitherto existed. By means of its life-like functions the social body becomes a living whole, and each of its new applications marks a step in the organization of human life.

We are thus conducted to the result of the highest philosophy: that society, in its form of organization, is human, and that it presents in its progressive development continually higher analogies with the laws of individual being. In passing from these general principles to scientific detail, in the illustration of the municipal fire-telegraph, we shall find some of these analogies presenting themselves in still more definite and striking forms, thereby setting their seal of confirmation on the natural arrangement of the system of telegraphic organization, which is the special subject of the lecture this evening.

Soon after the first introduction of the electric telegraph into this country, I conceived the idea of the municipal telegraph, as distinguished from the common form of telegraph connecting distant places. The telegraph, as you know, usually consists of a galvanic battery or generator of electricity in one city or town, and insulated wires or electrical conductors going out thence and proceeding to a register or telegraphic instrument in another city or town, which instrument indicates every electrical wave or impulse that is sent over the wires from the distant extremity of the line. This requires that there shall always be what is called a "circuit" of electrical conductors—that is, that the electric current shall have the opportunity of going out from one pole of the battery, through one conductor to the distant register, and returning through another conductor to the other pole of the battery. When this "circuit" is completed, an electrical wave or current immediately begins to pass through the conductors, though they may be hundreds of miles in length; and when the "circuit" is broken anywhere, it ceases to pass. All telegraphic signalizing is thus effected by alternately completing and breaking the circuit at suitable intervals.

The municipal telegraph, while it employs the same essential conditions, adopts a very different arrangement. Its function is not to connect distant towns or independent centres of life and activity with each other, but it is to organize a single city or town so as to bring every subordinate part into relation with its centre of government and direction. Its purpose is to multiply points of communication, to cover the surface of the municipal body as thickly, if you please, with telegraphic signalizing points as the surface of the human body is covered with nervous extremities or papillæ, the whole being intelligently connected into a system by which the municipal body shall understand itself in every part, and shall have a common life and vital functions for its own essential purposes.

The common telegraph is *linear*—it is a "line" of telegraph. The municipal telegraph is the application of the telegraph to a *surface*, making it cover a space with telegraphic nerves and papillæ as thickly as required, to furnish a complete organization. The common telegraph connects *distant* points, as its very name implies, the more distant the better to illustrate its character. The municipal telegraph contemplates the linking together of a multitude of *near* points, the nearer the better to illustrate the peculiarity of the system. The common telegraph connects two independent centres of life and activity. The municipal telegraph connects a multitude of subordinate points with one centre, and makes the position of those points dependent upon the centre and the needs of the system.

The occurrence of a fire in a city is one of the exigencies in which rapid and intelligent co-operation is necessary between the members of the municipal body. As our warehouses, manufactories, and public buildings are constructed, the extent of a conflagration depends to a great extent upon whether it is reached by the fire department within a short time or not. The first ten minutes in directing the alarm is worth hours afterwards. In organizing a system of fire alarms it becomes, therefore, necessary that every locality in a city shall have the means in its immediate neighborhood of notifying the existence of a fire. In order that this may be done systematically and under organic direction, it is necessary that this notification should be sent, in the first instance, to a common centre, which will naturally be at the city hall; and it is further necessary that the means should exist of giving thence an *instantaneous*, *definite*, and *public* alarm of fire.

The first requisite for a fire telegraph is certainly in its means of communication. What, then, are the safeguards of the municipal telegraph by which its indications may be made always reliable, and by which interruption, by accident or design, may be rendered improbable or impossible? These are the use of strong well-insulated wires, carried over the houses and attached to lofty and well selected buildings; the use of duplicate wires, following different routes, between all the stations, so that if one wire is broken from any cause, another and distant wire may still continue the circuit; and the dispensing entirely with the use of the ground as any part of the circuit, as used in common telegraph lines. Instead, also, of using, in a municipal telegraph, one great circuit which should traverse a whole city, a number of lesser circuits may be used, radiating from the centre, like the petals of a flower; so that if one circuit should be interrupted, all the others would still be intact and operative. These safeguards prove sufficient in practice to make the municipal telegraph the most certain means of communication which has yet been devised, under all conditions of weather and season.

In June, 1845, nearly ten years ago, I first published a notice of the fire-alarm telegraph, involving, essentially, the principles and safeguards upon which it has since been constructed. No definite action was taken upon it until 1848, when the subject was brought before the city government of Boston by the mayor, and two machines for striking the city bells from a distance, by means of the telegraph, were constructed under direction of Moses G. Farmer, esq., one of the ablest and most ingenious telegraphic engineers in the country.* One of these machines was placed in the belfry of the Boston city hall and connected with the line of telegraph extending to New York. Under these circumstances the operator in New York, by tapping on his finger-key, struck the bell on the city hall a number of times, and, according to the newspapers of that day, thus originated a false alarm of fire in Boston. This was the first illustration of the capacities of the fire-alarm telegraph.

The matter slept, however, till 1851, when I brought the system

* These original machines were exhibited, with other apparatus, in delivering this lecture; but for the sake of connexion, reference to the experimental illustrations will be excluded from this written report.

formally, and with specific plans, before the city government of Boston, and urged their action as due to science and to the public interest. This city government, unlike many others, induced only by the statement of scientific truth, voted ten thousand dollars to test a system wholly untried, and without precedent in the world. The mechanism and construction were placed in the hands of Moses G. Farmer, esq., and in 1852 were brought by him into thorough and successful operation. The American fire-alarm telegraph, in its development as a practical system of organization, tested now for nearly three years, should thus always be ascribed to Mr. Farmer equally with myself.

It has been stated that the conditions of the fire-alarm telegraph require that information should, in the first place, come in from any part of the circumference or surface of a city to its centre, and that thence an alarm should go out in a definite form to the public. The organization of a city under the system is as follows:

From the central station, at the city hall, go out wires over the house-tops, visiting every part of the city, and returning again. These are the *signal circuits*, by which the existence of a fire is signalized from any part of the surface of the city to the centre. Strung on these circuits, or connected with them, are numerous *signal boxes*, or signalizing points, of which there may be one at the corner of every square. These are cast-iron, cottage-shaped boxes, attached to the sides of the houses, communicating, by means of wires enclosed in a wrought-iron gas-pipe, with the signal circuit overhead. On the door of each signal-box the number of the fire district, and also the number of the box or station itself, in its district, are marked, and the place in the neighborhood where the key-holder may be found is also prominently notified. On opening the door of the signal-box a crank is seen. When this is turned it communicates to the centre the number of the fire district and of the box, and nothing else. Repeated turns give a repetition of the same signal. By this means any child or ignorant person who can turn a coffee-mill can signalize an alarm from his own neighborhood with unerring certainty.

Connected with the signal circuits at the central office, where they all converge, are a little alarm-bell and a register, which notifies and records the alarm received from the signal-box. The galvanic battery which supplies all the signal circuits is also placed at the central station. If a fire occurs near signal-box or station 5, in district 3, and the crank of that box is turned, the watchman or operator at the central station will immediately be notified by the little bell, and will read at once on his register the telegraphic characters which signify district 3, station 5. The characters used in the fire telegraph are a group of dots to indicate the district number—as three dots for district 3, and a group of dots and lines to indicate, by arbitrary characters, the station number. Thus a line and two dots may indicate station 5. These alternate on the record, and are repeated as often as the crank is turned.

The register used at the central station is generally the Morse register; which I recommend, in connexion with the system, as being most in harmony with its principle of operation.

We have traced the alarm of fire from a signal-box into the central

station. How shall the alarm be given from that centre to the public? From the central station proceed also several circuits of wires, called alarm circuits, which go to the various fire-bells throughout the city, and which are connected with striking machines similar in character to the striking machinery of a clock, but *liberated by telegraph.* The operator at the central station is enabled, by the mere touch of his finger upon a key, to throw all the striking machines into simultaneous action, and thus give instantaneous public alarm.

By what precise mechanism is this effected at the alarm-bell stations? The heavy hammers may be raised above the bells by any force which can be conveniently applied, as by a weight which may be wound up by hand. But in all cities where the water is confined under pressure in the mains, it will supply, by means of the eccentric water engine, known familiarly under the name of the "water meter," the power necessary to wield the heavy hammers with the greatest facility. But how are hammers of one or two hundred pounds weight to be tripped by telegraph? To effect this readily Mr. Farmer invented his electro-magnetic escapement, one of the most beautiful and original of recent mechanical applications. In this escapement the electro-magnet, when it becomes charged by the galvanic influence received from the central station, attracts the little piece of soft iron or armature in front of it, which supports a small lever poised nearly vertically, and weighted with a little ball at its upper end. This lever and ball, when tripped by the withdrawal of the armature, acquires sufficient momentum to strike up the *detent* of the train of wheels which, in their revolution, raise the hammer and then allow it to fall. A single blow of the hammer follows each electrical impulse sent from the central station, and the revolution of the train of wheels raises also the falling lever into its place and catches it again on the armature lever, ready to be disengaged or tripped for another blow.

At the central station, connected with the alarm circuit, is a galvanic battery and an instrument for completing the circuit of that battery, called the district keyboard. This is constructed with several keys, corresponding to the numbers of the fire districts in the city. If you depress any of these the machinery inside commences to move, and the circuit is completed at such intervals as to strike and repeat on the distant alarm bells the district number represented by that key with suitable pauses between.

We supposed that the operator at the central station received the signal of fire from district 3, station 5. He now places his finger on the key of district 3, in the keyboard. Instantly all the alarm bells in the city begin to strike synchronously the district number *three*, and continue, no matter what their number or what the weight of their hammers, so long as that single finger rests on that key.

But the operator has a finger key before him connected with the signal circuits, by which he can answer back and strike a little electro-magnet, armature, and bell, enclosed in each signal box. He has received a signal of fire from district 3, station 5. While his hand rests on the key of district 3 he taps occasionally *five* times on the return key of the signal circuits, which I have just described. The little bell in each signal box, at the corner of every square, strikes *five.* The fire-

man listens to the public alarm bells and gets from them the number of the district; he runs by the nearest signal box and listens a moment to gather the station number from its little signal bell, and he now knows that the fire is at district three, station five. He directs his own motions and his engine, from the start, to within, perhaps, one hundred yards of the fire.

No other system has ever attempted to localize a fire more precisely than by the district number; and in some cities, like New York, the districts may be two miles long.

In all previous systems there has been a delay, first in getting an alarm from the fire to the bells, and, second, in finding the place of the fire in the district after the alarm was given, and reaching it by the shortest route. By the fire telegraph both district and station are publicly notified; the one by the alarm bells, the other by the signal boxes.

Let us now consider for a moment the analogy between the municipal organization thus described and the nervous organization of the individual. A coal of fire falls upon my hand; one of the nervous extremities, or papillæ, the "signal box" of the part, sends instantly its own special signal, by means of a nerve of sensation or signal wire to the brain, where the existence and locality of the lesion is at once recognized. An act of intelligence and volition ensues. The watchman of the central station, or brain, does his part. An impulse to motion is sent out over the proper motor nerves, or alarm wires, and muscles are called into play in a suitable manner to remove the cause of injury, just as the electro-magnetic muscles and iron limbs in the bell towers are thrown into suitable and related action to the original cause and place of alarm.

The telegraph, in its common form, communicating intelligence between distant places, performs the function of the *sensitive* nerves of the human body. In the fire telegraph it is made to act for the first time in its *motor* function, or to produce effects of power at a distance; and this is also connected with the sensitive function, through a brain or central station, which is the reservoir of electric or nervous power for the whole system. We have thus an "excito-motory" system, in which the intelligence and volition of the operator at the central station come in to connect sensitive and motor functions, as they would in the case of the individual.

The conditions of municipal organization absolutely compelled the relation of circuits which has been described. The analogy with the laws of individual life was not perceived until after the system was evolved, and it came then as a confirmation of the correspondence of the system to natural law, and of the necessity of the arrangement as a means of order.

I should not be precluded from saying in this place, what historic truth at this time requires, that the development of the "motor function" of electricity, or of the means by which electro-magnetic power can be exerted at a distance, is due to the early experiments of the Secretary of this Institution, Professor Henry, whose discoveries in electro-magnetism and especially of the quantity and intensity of the magnet in 1830, laid the foundation for all subsequent forms of the electro-magnetic telegraph, and made subsequent steps comparatively

easy. In the publication of these experiments, the induction of the electric telegraph as thenceforth possible was distinctly made by him; and at a period not much later, weights were released and bells rung by him at a distance by electric influence transmitted through long conductors.

In Boston, where the fire-alarm telegraph has been in successful operation for nearly three years, a star of wires is seen radiating from the top of the city building. These are the signal circuits connecting into one system forty-six signal boxes scattered over the city, and the alarm circuits connecting twenty-four belfries on church, school and engine houses. A few large bells would be preferable to this multiplicity of smaller ones, but this whole number are struck by the touch of a single man's finger in the central station. For the sake of economy in battery power, the district keyboard is so arranged as to throw the battery on the four alarm circuits separately, but in rapid succession at each blow. Practically, the bells strike together or as much so as is desirable. At night, sometimes out of the profoundest stillness, the district number will suddenly strike upon the ear in a chime of perhaps eight or ten bells, their sound coming in one after the other in proportion to their distance from the ear, but always in an invariable succession at each blow. Then the alarm ceases and the whole city is as suddenly silent.

The operator at the central station is sometimes able to throw the bells on, and tap back to the signal boxes before the originator of the alarm has ceased to turn his crank in the immediate neighborhood of the fire. As soon as the bells strike, groups of persons will be seen clustering round each signal box to listen to the tapping of the station number, and it is soon known to the whole fire department exactly where the alarm originated.

The battery employed on the Boston signal circuits is Farmer's protected Grove's battery, which keeps in action several weeks or even months without being replenished. Instead of a galvanic battery on the alarm circuits, a large magneto-electric machine has been recently substituted, which is driven by a water meter, and which furnishes the electric current by which the bells are rung.

The heaviest hammer in the system at Boston weighs one hundred pounds, and it is wielded by the Cochituate water at an expense of only one gallon for each blow, and tripped by telegraph from a distance of two miles. By virtue of the electric current and the pent up water, this bell, and others associated with it, might be rung in measured strokes from the beginning to the end of the year by the pressure of a single man's finger in a distant room.

All of the stations in Boston are provided with "lightning catchers" or ground conductors for atmospheric or induced electricity. Hence an incidental protection from lightning commensurate with the extent of the network of wires above is obtained for the city. When these ground conductors have been temporarily removed from the alarm-bell stations, a flash of lightning has been occasionally followed by a single blow from one or more of the bells. But where the lightning catchers have been in place, they have proved sufficient, except in rare instances, to divert atmospheric or induced currents from the electro-magnets to the ground. No practical or serious inconvenience has resulted

from this source. But it has occasionally been a matter of curiosity and interest to hear the lightning thus tolling the alarm bell.

The total loss by fire under the telegraph fire-alarm system, according to the accurate "Report of the Boston Fire Department for the year 1854," was only $150,772, or less than one dollar for every inhabitant; a loss which, for its small amount in so compact and wealthy a city, cannot be paralleled in America.

Out of 195 alarms of fire in Boston in 1854, *twelve* are recorded as false; but at least *six* of these were from supposed fires, leaving only *six* unaccounted for. The whole number of alarms and the proportion of false alarms have been greatly diminished by the system. Science can make no contribution to civilization without the requisite social conditions. The trust of the fire telegraph system, in this case was placed in the hands of the citizens, and it has yielded to them its full fruits without abuse. This may deserve perhaps to be chronicled as an instance of well rewarded confidence in the sobriety and capacity for self-government of the American people. The signal box, which is the sensitive extremity of the system, may be protected by various methods according to social requirements. In Boston it has been guarded by putting it in the most public place and exposing it to the fullest light.

The fire-alarm telegraph contains also the elements of a perfect police system. In addition to the crank for alarm, every signal box is provided with a finger key, by means of which communications in the ordinary telegraphic method can be sent to the central station, and an answer can be returned from the centre and read by sound from the little bell in the signal box.

The mechanism of the fire telegraph is arranged and disposed for the purpose of preserving wealth, the fruit of human industry and of nature's bounty, from destruction. It therefore accomplishes an end of human use. But more than this, it is a higher system of municipal organization than any which has heretofore been proposed or adopted. In it the New World has taken a step in the forms of civilization in advance of the Old.

LECTURE V.

BY PROFESSOR HENRY REED, OF THE UNIVERSITY OF PENNSYLVANIA.

[The publication of these lectures will awaken in the sympathizing hearts of many of their readers a painful reminiscence of the loss in the Arctic of their amiable and gifted author.]

THE UNION.

FIRST LECTURE.

The subject upon which I propose to address you is the growth of the American Union during the colonial era of our history. In treating such a subject, at the present time, it is my desire to say, in the first place, that I shall purposely forbear speaking of the Union as it now exists, with its manifold and countless blessings, its present estate, and its prospects. It is the retrospect which I intend to turn to, and in that retrospect there is abundance both of admonition and encouragement for all after time, much to inspire a thoughtful loyalty to the Union, and a deep sense of responsibility for each generation coming to live within that Union, and to transmit it unimpaired to posterity, such as it has grown to be, not by man's will or sagacity, but by the providential government of the world, which may be traced in the history of our race.

In speaking of history as making manifest such providential government of the world, I do but recognise and follow one of the highest principles which we owe to the improved culture of historical science in the present century. That improvement is not alone in more laborious and dutiful habits of research, in the more studious use of original documents, but in a truer philosophy of history, not such as in a former age, arrogating the title of philosophy, contracted its vision within the scant range of scepticism, but a philosophy which reverently traces on the annals of the human race marks of more than human agency—an overruling Providence. As in that which is especially denominated "*sacred* history" the purposes of the Creator are expressly revealed, so in that which is styled, in contradistinction, "*profane* history," as purposes of the same Creator must needs exist, the thoughtful student may gain at least some glimpses of them, and yet refrain all the while from rash interpretation of the Divine will in the guidance and government of man and of the races of man to whom the earth is parcelled out.

It becomes more practicable to trace the providential purposes when we look over long tracts of time. The history of Rome, for instance, with its twelve centuries of growth, and decay, and ruin—in one point of view, what is it but a purposeless record of strife, external and internal—conquest and the domestic feud of patrician and plebian—

and ended, at last, like an unsubstantial pageant, leaving no influence behind it; but, in another point of view, it becomes a more intelligible memorial of the life of a nation that had a destiny to fulfil, an appointed work to do—to build up a system of law which should enter into modern European and American jurisprudence, and with its strong Pagan power to pave a path for Christianity to travel into the vast regions which at one time were included within Roman dominion.

Now, turning to American history, and especially that portion of it which is devoted to the Union, it is possible, I believe, to place the events in such combinations, to discover in them such a concurrent tendency, as to leave no room to question that those events were controlled as the secondary causes of the results to which form was given in our system of government. From the latter part of the last century—from the year of the adoption of the Constitution of the United States of America, with its primary purpose of forming *a more perfect union*, back into the century of English colonization, back still earlier to the years of discovery, and even earlier yet to those remote centuries in which, many generations before Columbus or Cabot, European eyes, we may believe, beheld this continent for the first time—throughout that long tract of time there is, I do not fear to say, a tendency more or less visible towards the future results, and not least among those results towards this Union. That tendency may be traced both in what was frustrated and in what has been achieved; so that all things seem to lead to this result, the predominance in North America of one European race, and that race the race which speaks the English tongue. I thus entitle it for the want of a better and briefer name. The title "*Anglo-Saxon*" is hardly adequate or expressive enough for a breed of men in whose veins there runs the mingled current of Saxon and Norman blood, perhaps of ancient British, Celtic, Roman, and Danish blood. From the earliest time in which intercourse began between the eastern and western hemispheres down to our own day, the great movement has been the extension of what may be called *Saxondom*—a part of that larger movement, not confined to North America, but extending to southern Africa, to India from Ceylon to its northern mountains, and to Australia and the islands in the distant seas—the movement which is carrying the language and the laws of our race widely over the earth.

My present purpose is to look at this movement as it has a connexion with American history, and especially with the Union; and, without attempting in any way to make historical facts bend to hypothesis, to show that the history of discovery, the history of colonization and of colonial government, all establish this historical truth, that the work of laying the foundation of a great political system in North America was reserved for the race that speaks the English language, by whatever name we may choose to call that race; further, that, in order to develop so essential a part of that system as the union of a federal republic, the work was reserved for the English race at a particular period of their history in the mother country. Thus it is to remote causes that we are to trace that political power which animates a government extending from the lakes to the Gulf of Mexico, and from the Atlantic to the Pacific.

It seems to me that there is no consideration better calculated to deepen in the mind of every reflecting citizen a reverence for the Union than a just sense of its origin; and that is to be acquired by the studious asking and answering of this question, How was this Union formed? Has the origin of the Union a date—a day or a year? Can we find its epoch—as of independence, or of the confederation, or of the Constitution? Was it done in convention? Did men come together by some delegated authority and deliberate in solemn council, and ordain a Union? Never. It was the work of time, the natural consequence of events, a growth from circumstances, or whatever other phrase may be used as a substitute for an express acknowledgment of a Providence in the destinies of mankind. It is not possible to trace the Union to any premeditated plan, the idea of any one man, or the concert of any body of men. You can find no authority to pronounce it the direct product of human foresight, of political wisdom and experience. You cannot point to any day in our history, and say that on such a day Union existed, and on the day before there was nothing of the kind. In truth the Union was not made, *it grew*. It grew as the tree grows, planting its roots deeper and deeper, and lifting its branches stronger and stronger and higher and higher, its vital forces coursing upward and outward to its lightest leaf. The Union grew as the forest grows, and the seed was not sown by man's hand. This element of government is at the same time an element of national character. It is part of the life of Saxon liberty, and it came with the Saxon race to be developed and expanded in a land which seems to have been reserved to be the Saxon's heritage.

Whatever may have been accomplished when European enterprise began its work on this continent with those long unknown or forgotten discoveries of the Scandinavian navigators, who, 500 years before Columbus, were the first to behold these western shores, those obscure voyages left no abiding influence here. The Northman had no distinct destiny here; and idle as it would be now to speculate on such a future as there might have been if Scandinavian discovery had been followed by conquest and settlement, one cannot help thinking how fruitless would have been the strife between the savage *native* races and the fierce uncivilized barbarians of the northern seas. This land was not meant for the Northman's home. The voyages of the eleventh and twelfth centuries passed away, leaving no trace behind them, and, what was more important, leaving the land open to the enterprise of other and distant generations who had a destiny here.

When, in the fifteenth century, the south of Europe was stirred by the spirit of maritime adventure, and Portugal took the lead in it, the enterprise of that kingdom found a southern and not a western direction, in the voyages along the western coast of Africa, planned by that remarkable personage, Prince Henry (a Plantagenet by the mother's side, let me say in passing.) This land was not given to the race of Portugal first, though they were among modern discoverers.

When Spain slowly followed the career of which the neighboring kingdom had set the example, and when Columbus had nearly crossed the Atlantic, steering due westward to the continent of North America, then only a few days' sail distant, a flight of birds, as is familiarly remembered from the well known story, were seen winging their way

across the course of the vessels, and the great navigator following those pilots of the air southwestward, lost the continent, and the power of Spain was planted only on the islands. As a flight of birds gave, according to the legend, augury for the first doings of Rome's history, so in another way it has a place in our earliest annals. Again, on his second voyage, the path of Columbus lay among the islands; and when the papal power was invoked to determine the disputes between Spain and Portugal, respecting their rights of discovery, and Alexander VI adjudged his famous partition, which seems to appropriate to these two contending powers all that was discovered, and all that was to be discovered in the new world—soon after this exercise of power, (more than human by one less than human in the crimes that have made the name of Borgia infamous,) soon after, the sovereign of a country which held slacker allegiance to Rome, gave the commission to the Cabots, and that authority, which has been well styled "the oldest American State paper," set the Saxon foot upon this soil, the first of European feet to touch the continent. The land was not meant, either by claim of discovery or by papal gift, to be the Spaniards' home. The two small English vessels which had cleared from Bristol, "with authority to sail to all parts of the east, west, and north, under the royal banners and ensigns, to discover countries of the heathen, unknown to Christians, to set up the king's banner there, to occupy and possess, as his subjects, such places as they could subdue, with rule and jurisdiction," coasting along perhaps some thirty degrees of latitude, from Labrador to Virginia, gave to an English race their title here. Thus early, within a very few years after the beginning of western discovery in the fifteenth century, was laid the foundation of future dominion; for whatever other European races might thereafter seek a home on this portion of the continent, it would be only for such partial or temporary occupation as would sooner or later be absorbed in the occupations by that race which was then, in that era, the first to touch the mainland. It was thus that the way was prepared to make the country the heritage of that race which speaks the English tongue, a race in whose institutions the name of PEOPLE was never lost, whether in their furthest antiquity in the forests of Germany, or under Saxon, Danish, or Norman rule, after their migration to Britain, whether under the kingly confederacy of the Saxon, or under the power of the strongest Norman sovereigns, Plantagenet or Tudor; so that, with the popular element ever present, every political struggle has been either to regain something lost, or to expand and improve some ancient right.

In studying the originating influences of our institutions, political and judicial, there can be no question, I believe, but that the first influence is to be sought in the character of the race. Powers and habits of thought and feeling come to us with our blood, and extend to all who come within the range of their influence. We have but expanded what the Saxon began more than a thousand years ago, before, indeed, the races of the north had a history of their own or a place in the history of the more civilized south. The influence of race is most obvious when we think of the inheritance of the common law, or such a special tradition, from unknown origin, as the trial by jury. My present purpose is to trace the agency of the same principle, I mean the influence

of race, where it is less apparent, in that part of our political system which is expressed by the term "the Union," and then to follow it onward through the processes of colonization and the course of colonial government.

The question to be considered is, what element was there in the Anglo-Saxon character and institutions, which, being transplanted to this country, and being left to freer and more unrestrained action, would facilitate the formation of a federal government, of a Union? Such an element is to be found in *the tendency to local self-government*, which is characteristic of the race, and is conspicuous in the history of their institutions. This is a tendency the very reverse of that which is described by such terms as "*centralization*" or "*consolidation*." Saxon freedom has, no doubt, been held chiefly on the tenure of this principle, that the central power of the State has always recognised a great variety of local powers. Even with regard to metropolitan influences, how obvious is it that London has never been to England what Paris has been and is to France, whether royal, imperial, or republican France. It has been justly said that "centralization and active life pervading the whole body are hard to reconcile; he who should do this perfectly would have established a perfect government. * * It seems to be a law that life cannot long go on in a multitude of minute parts without union; nay, even without something of that very centralization which yet, if not well watched, is so apt to destroy the parts by absorbing their life into its own; there must be a heart in the political as in the natural body to supply the extremities continually with fresh blood."—(*Arnold.*)

Now, throughout the whole history of our race—the race that speaks the English tongue here and in England, during the three score years of our Constitution, during the brief existence of the confederation, during the contentional colonial period between 1763 and 1776, and during the earlier colonial times, or, in the mother-country, during the various eras of the history of the race there—it has been the combination of these two principles—the principle of *centralization* and the principle of *local independence*—that has distinguished the race, that has made its power, its safety, and its freedom. Political strength and health have been in the just distribution and harmony of these powers, having an archetype, it may be said, in the tranquil and perpetual harmony of the solar system—the noiseless on-goings of the stars. In the political system of the Saxon—royal or republican—the danger has ever been in any excess of either the centripetal force on the one hand, or the centrifugal on the other. Whatever variations there may have been from time to time, this may, I believe, safely be pronounced the great Saxon characteristic—a habit of local government, exercised in a certain subordination, or rather relation, to a central government. And further, it would not be difficult to discover in such distribution of power in local institutions much of the discipline, the training for more expanded opportunities of government, which has helped onward what appears to be the destiny of the race. Observe how, after the Saxon occupation of Britain, the conquered territory, small comparatively in extent, was divided into several petty kingdoms—those loosely compacted kingly commonwealths which were to form

the heptarchy; and again, how each of these was parcelled out into those various divisions, the counties, shires, hundreds, tithings, and other partitions, the origin of which perplex the antiquarian. The old Saxon spirit of local independence and authority animated the local institutions, assemblies, tribunals of various kinds, with an energy that never could have been developed under a strongly controlling central power.

When the Norman conqueror sought to complete the subjugation of England, by introducing the laws and institutions of his own country, and a rigorous establishment of the feudal system, all this Saxon variety of law, of usage, of manners, and of men, was a perpetual hindrance, which it was part of the conquest to do away with. The conqueror's strong hand was laid on the free diversities which the Saxon had been used to of old, for conquest, dominion, empire, demanded more of a submissive uniformity; and accordingly, as an instance of it, we find the conqueror introducing, for the administration of justice, an office unknown to the Saxon—the office of chief justiciar. The biographer of the English Chief Justices remarks, in the opening sentence of his work:

"The office of Chief Justice, or Chief Justiciar, was introduced into England by William the Conqueror, from Normandy, where it had long existed. The functions of such an officer would have ill accorded with the notions of our Anglo-Saxon ancestors, who had a great antipathy to centralization, and prided themselves upon enjoying the rights and the advantages of self-government.

* * * "In Normandy, the interference of the supreme government was much more active than in England; and there existed an officer called CHIEF JUSTICIAR, who superintended the administration of justice over the whole dukedom, and on whom, according to the manners of the age, both military and civil powers of great magnitude were conferred." Lord Campbell adds in a note: "It is curious to observe that, notwithstanding the sweeping change of laws and institutions introduced at the conquest, the characteristic difference between Frenchmen and Englishmen, in the management of local affairs, still exists after the lapse of so many centuries; and that, while with us parish vestries, town councils, and county sessions are the organs of the petty confederated republics into which England is parcelled out, in France, whether the form of government be nominally monarchical or republican, no one can alter the direction of a road, build a bridge, or open a mine, without the authority of the 'Ministre des Ponts et Chaussées.' In Ireland, there being much more Celtic than Anglo-Saxon blood, no self-reliance is felt, and a disposition prevails to throw everything upon the government."

This Saxon characteristic is to be discovered not only in the number but also in the diversity of local institutions, arising from diversity of character and traditional influences. Although in the course of time—many centuries—such diversities have been smoothed down by many assimilating processes, perhaps no country on the face of the earth, within so narrow a space, presents so great variety of customs as England continues to do. Habits, manners, the tenure of land, rules of inheritance, display a free variety strongly contrasted with the servile

uniformity of governments with stronger controlling central powers. Usages which appertain to the North Briton are unknown to the South Briton—the man of Kent, or Cornwall, or Wales. The cities and towns have a variety of municipal power and privilege resting on the authority of immemorial usage.

The origin of all this diversity, in which there has been developed so much of practical power, is to be traced to the same cause which has transmitted it to America—the mode in which the land was occupied by the successive races who came to its shores. The Roman conquerors and colonists, the continued migrations of the Saxons, the abiding incursions of the Danes, the conquest by the Norman, each brought and left an influence, a set of laws or customs at the least; and in the after ages, no tyranny was strong enough or senseless enough, no revolution was rash enough, to attempt that worst of all revolutionary havoc, total obliteration of the past, the absolute subjugation of local variety and independence.

Such diversity may possibly offend the merely speculative mind, which is apt to crave that which is squared and levelled to a more theoretic exactness and completeness; but it is the power which has been disciplined by such diversity, and the freedom that accompanies it, which has spread the race over the earth, and has engendered our Union. It is well known that in material nature, in the lower orders of creation, considerable *uniformity* is met with; but that the higher we ascend, the more diversity is found. A great modern historical philosopher adopted, as a leading principle in his science, this truth, that "as in organic beings the most perfect life is that which animates the greatest variety of numbers, so among States that is the most perfect in which a number of institutions originally distinct, being organized each after its kind into centres of national life, form a complete whole."

Now I believe that it is possible to show that during the whole of our colonial era, during what may be called the *primitive* period of our political institutions, the whole course of events tended to the establishment of this principle thus philosophically stated by Niebuhr. I mean to say explicitly, that the providential government of the doings of men on this portion of the world, and with reference to this portion of the world, from the discovery of it onwards to the adoption of the Constitution of the United States, has led on to what has been described as the highest form of political life, a republican system including the principle of distributed local government, in the parlance familiar to us, "a Federal Republic," or in the philosophical language of the historian whom I just quoted, "a complete whole, formed of a number of institutions," originally distinct, organized each after its kind into centres of life. I am aware that it may sound presumptuous to speak confidently of the purposes of the providential government over the world, or over portions of it, or over the movements of this or that race. But when the principle of a providential government of the human race is recognised, as it must be by every mind whose belief has advanced beyond the confines of absolute atheism, and also, during a long course of years, near three hundred years in the case to which I wish to apply the principle, you can trace a correspondence between the events on such a period and a

final result, I do not know why we need fear to affirm that those events were providentially controlled and guided to that result. This conviction is further strengthened when we can perceive beyond such result adequate consequences, can see how that result was in the future to be productive of good. The evidence of such consequences is in the knowledge that the form of government which alone renders popular institutions compatible with extent of territory, is that form which has its origin in this ancient element of Saxon local self-government. Who can question that it is such a political system that has expanded this republic from its primitive circumscription to its present extent, so that that which at first reached not far beyond the sound of the Atlantic, became enlarged beyond the mountains; then beyond the Mississippi; and now, having crossed the second great mountain range of the continent, has on its other border the sound of the earth's other great ocean. I know of no grander traditional influence to be observed in history, than this simple Saxon characteristic element and the mighty issues of it now manifest around us, the connexion between this principle of local government obscurely recognised in the ancient fatherland of the Saxon, carried thence to England to be combined with the central power of a constitutional monarchy, and now a living principle here, helping, by the harmony of state rights and federal energy, to extend and perpetuate the republic.

On an occasion like the present, I do not propose to attempt to enter into the details of American colonization, or to dwell upon the familiar story of our early history, but rather to use them only so far as it may be necessary to illustrate the principle I have endeavored to set forth. A rapid review of colonial events, brought into a new connexion and concentered on one principle, will, I hope answer the purpose of maintaining the historical argument which I desire to submit to you. There is perhaps nothing in our early history which now appears more remarkable to us than the long delay on the part of the English government, or the English people, in making use of the title which the right of discovery had given them to the soil of America. It presents a curious blank, near a century before any attempt was made to occupy or to colonize the newly discovered land, and more than a century before a permanent settlement was accomplished.

It has been remarked, that the only immediate result of Cabot's voyage and discovery of the continent, was the importation into England from America of the first turkeys that had ever been seen in Europe. Such was the beginning of the immense commerce between England and America. For a long time the right of discovery seemed a barren title; and it is a noticeable fact that while it was the first of the Tudor kings whose commission authorized Cabot to set up the English banner here, it was the last of the Tudor sovereigns who sought to make her title here a reality by planting English homes; and indeed the whole dynasty passed away without anything permanent being achieved. Doubtless, the delay was salutary, was propitious for the future; and perhaps we can conceive how it was so when we recall the character of that Tudor dominion and the spirit of that age. It was not the temper of that dynasty to give the colonial free-agency (it might almost be called independence) which was to prove the germ of republican

nationality. It was not the spirit of that age to ask for such large power of local government as by a later generation was quietly assumed and exercised. The ancient Saxon element of local self-government could not well have been transplanted here, while the strong rule of the Tudor was centralizing so much about the throne; and therefore, (I speak of it as an inference in the logic of history,) the whole sixteenth century passed away and the land was still the natives'; for when the year 1600 came, there was not an English family, no English man or woman, on this continent, unless perchance there was wandering somewhere some survivor of Raleigh's lost colony.

It would be vain now to speculate upon the influence which might have been exercised on the destinies of our country if that which was the perishable colonization of the 16th century had been permanent. But a knowledge of what was attempted, and of the manner of it, serves to show that it would have been different in character, and therefore in its influences from the later colonization.

When, in 1578, Sir Humphrey Gilbert obtained from Queen Elizabeth letters patent, authorizing him to discover and colonize remote and heathen lands—the first grant of the kind ever made by an English sovereign—there was conferred upon him almost a monopoly of the right of colonization, with privileges and authorities for the government of his designed colonies of almost indefinite extent, and with a prohibition upon all persons attempting to settle within two hundred leagues of any place which Sir Humphrey Gilbert or his associates should occupy during the space of six years. While we may deplore the adverse fortunes of this brave voyager—his baffled enterprises and the pious heroism of his dark perishing in the mid-Atlantic—it is not to be lamented that a scheme of colonization so vice-regal in its character; should not have been accomplished. The same comment may be made on the grant to Sir Walter Raleigh—which was of prerogatives and jurisdiction no less ample—to end, after repeated efforts and the well known expeditions which he sent out to the new world, in disappointment and a name; for all that has proved perpetual from those enterprises is the word "*Virginia*"—a title given, for a considerable time, to an almost indefinite region of America.

Let me here take occasion to state that some recent investigations of the State records in England, and particularly a hitherto unnoticed entry on the close-roll of the 24th of Elizabeth, have established the fact that another illustrious public man of those times—Sir Philip Sidney—had turned his earnest and active mind to American discovery, and probably contemplated a voyage in his own person to the western hemisphere. That he did so as early as 1582—which was earlier than the voyages equipped by Raleigh—is a fact, the evidence of which has but very lately been discovered, and was published, for the first time, only in the month of February, 1850. It appears that Sidney obtained from Sir Humphrey Gilbert, under the Queen's patent to him, a right to discover and take possession of three millions of acres in America. The grant was large enough to be almost indefinite, and is another instance to illustrate the policy of colonization which prevailed in that generation.

Although Sidney's meditated enterprise was relinquished, it is

pleasing to find associated with the early plans of American colonization the name of one who has left so matchless a memory—the scholar, statesman, poet, the friend of poets, the soldier whose early death was mourned by a nation—a death memorable with its last deed of heroic charity, when putting away the cup of water from his own lips, burning as they were with the thirst of a bleeding death, he gave it to a wounded soldier with those famous words, eloquent in their simplicity, "*Thy necessity is yet greater than mine.*"

Permit me to extend this digression a little further to notice an American allusion which occurs in the English literature of the same period in which Sir Philip Sidney flourished. When, in 1590, Spenser gave to the world the first part of "*The Fairy Queen,*" he dedicated that wondrous allegory to "The most high, mighty, and magnificent Empresse, renouned for pietie, virtue, and all gracious government, Elizabeth, by the grace of God, Queen of England, France, and Ireland, and VIRGINIA." Yes, there stands the name of that honored State—then, as it were, the name of British America; and while there is many a reason for the lofty spirit of her sons, the pulse of their pride may beat higher at the sight of the record of the "Ancient Dominion" on the first page of one of the immortal poems of our language.

To return to my subject. It can readily be perceived that such schemes of colonization as were planned during the reign of Elizabeth—, Sir Humphrey Gilbert's, Sir Philip Sidney's, Sir Walter Raleigh's—could hardly have resulted otherwise than in the establishment of vast feudal principalities, to continue under rulers who would have been no less than viceroys, or to be resumed under the immediate sovereignty of the throne. Such occupation of the land could scarce have led on, by any natural sequence and series of events, to a popular government—still less to a political system in which the element of "Union" would exist. There would not have been enough of partition. There would not have been enough of either the spirit or the privilege of distinct and separate colonization—the establishment of communities independent of each other, destined in a later age to grow so naturally into Union. Colonization then would have been too much like that of France in Canada—something far more regular and uniform, and imposing in appearance as an affair of State; but fraught with no such momentous power of development as was latent in the freer Saxon method. There would have been far less of that "*wise and salutary neglect*" which Mr. Burke spoke of when, in his speech on conciliation with America, he said: "The colonies, in general, owe little or nothing to any care of ours. They are not squeezed into this happy form by the constraints of watchful and suspicious government; but through a wise and salutary neglect, a generous nature has been suffered to take her own way to perfection." It was, indeed, "a wise neglect." But let me add that it was a wisdom which cannot, with accuracy, be predicated of a passive, negative, neglectful State policy, but of the providential guidance of the race by which there was bestowed upon them the freedom of self-discipline, of political power and expansion. It sounds like a paradox and a contradiction; but it is an obvious truth that the first element of union is separation—distinctiveness of existence and of character. The history of union begins not with *unity,* but with

the creation of such separate existences as in the future may, by some process of assimilation and connexion, become united but not consolidated—forming a complete whole, the portions of which do not lose their distinct organization.

Passing onward from the perishable colonization of Queen Elizabeth's times to that colonization which proved permanent, it is apparent that it did take that form, and direction, and character, the natural though distant results of which are to be seen in what is now around us. This holds good of the whole period of English colonization in America, from James the First to George the Second—a century and a quarter; from the arrival of the first permanent colony in Virginia, and the building of Jamestown, (1607,) down to Oglethorpe's settlement of Georgia, in 1732.

The grant to Sir Walter Raleigh having become void by his attainder, British America was again in the King's gift—and that King the first of the Stuarts. Now, although the notions of royal prerogative which were cherished by the Stuarts were as high as those of the Tudors, still the relative position of the sovereign was changed, for the progress of constitutional government had developed new sentiments of allegiance and new powers of resistance. The seventeenth century, which, in fact, may be called the century of American colonization, for it comprehends nearly all of it, was more propitious than the previous century to the planting of colonies destined to grow to a republic. The process of partition now began—giving scope therefor to the ancient Saxon principle of local government. It was at first, as is well known, a simple twofold partition; for when king James the First granted the patent for the territory stretching from the 34th to the 45th degree of latitude, he divided it between the two companies, the Southern or London company, and the Northern or Plymouth company. By virtue of these grants, and the settlements under them, the country was parcelled out into two great divisions, soon known by the familiar designations of Virginia for the former, and New England for the latter.

I do not propose on an occasion like this to trace the detailed series of grants and settlement: it is enough for the present to remark that the course of colonization was a continued process of partition; so that in 1732, at the time of the Georgia settlement, the strip of territory along the coast of the Atlantic, which then formed British America, was divided into the *thirteen colonies*—a colonial system fashioned into thirteen distinct political communities.

This was not merely *territorial* partition; political and social varieties distinguished the colonies. This was a consequence of what was a remarkable peculiarity in the English settlement of America, that colonization was *individual* enterprise, receiving the sanction but not the support or assistance of the government. No colony in the seventeenth century, to which period they nearly all belonged, had any direct aid from king or parliament. The solitary exception occurred in a parliamentary grant of aid to the Georgia colony. Colonization which was individual enterprise partook of the variety of individual character and motive—of the different and even conflicting principles, civil and ecclesiastical, which were dominant or depressed at different periods of the seventeenth century. This, it seems to me, is well wor-

thy of notice, that no century of English history, either earlier or later, was so calculated to give character—and varied character, too—to the colonies, as that century which was the century of colonization—the seventeenth. It was an age in which the activity of the nation, theretofore busy in other directions, was turned to questions of government. The thoughts of men were anxious and occupied—not with questions respecting the succession of this or that branch of a royal family, but with the principles that lie at the very foundation of government, the limits of power, and the rights and duties of the subject. It was an age—better than any other in the annals of the mother-country—fitted to send along with the sons who left her to seek a distant home the dutiful spirit of loyalty, willing obedience to law, and the dutiful spirit of freedom—the two great principles of constitutional government. There was political variety, as well as social; for the colonial governments, although all bearing a resemblance to the government of the mother-country, had those distinctive characteristics by which they are classified into the Royal, the Proprietary, and the Charter governments.

It seems strange that the colonial policy of one kingdom should admit of such a diversity, that in some the king's control was perpetually present; in others it was transferred to lords-proprietary, subjects to whom was given the half-kingly power of palatines; and in others so free were the charters that the people, for a long time after the royal authority was wholly abrogated by independence, asked no change in them. Strange as such colonial diversity appears, it was far more favorable to the future results than any uniform system of colonial government.

I have endeavored to show that a principle, which may safely be said to be a characteristic of our race, in all regions of the earth, has been brought hither to become a great element in our national system; and, further, that throughout the whole period of discovery and colon zation, whatever was adverse to that principle was checked or frustrated; while, on the other hand, the tendency of events was to the steady development of that principle—the creation of the materials for *Union*.

In the next lecture I propose to consider the process by which those materials were brought together, without the loss of their distinctive character, as component parts of the Union.

THE UNION.

SECOND LECTURE.

Having considered, at the close of my last lecture, the partition of British America into the several colonial governments, I propose now to ask your attention to the events and influences which combined without consolidating them—in other words, the formation, or, more properly, the *growth of the Union*. For this process there were needed two powers of an opposing nature—a centralizing and a repulsive power—the former to give connexion, the latter to preserve the distinctive local organization.

Let me remark, by way of introduction, that in studying the history of the Union the mind is peculiarly exposed to that unconscious delusion, so frequent in historical studies, which consists in allowing notions and impressions of the present time to enter inappropriately into our estimate of the past. It is thus that we often deceive ourselves with unperceived anachronisms. The complicated frame-work of our political system has been for more than half a century acquiring strength and solidity by the actual working of the system and by the imperceptible processes of time. There are the countless interchanges arising from an active commercial spirit, the progress of the arts is speeding and facilitating intercourse to an extent never dreamed of in the olden time, there are the thousands of social affinities of interest and affection by which fellowship is created and confirmed between various and remote sections of the country. Conceive for an instant the possibility of a knowledge of the written intercommunication, on any one day, transmitted by the agency of the post office or the electric telegraph, what a story it would tell of strong and incalculable affinity—political, commercial, social—of community of traffic and of feeling, precious and far-reaching! So habitually familiar to us is all this, that when we turn to an early era of our history we are apt, unawares, to carry our present associations back where they do not belong. Familiar as we are in our day and generation with the recurrence and easy gathering of conventions, composed of delegates from all parts of the Union, for every variety of purpose—ecclesiastical and political, scientific, educational, commercial, agricultural, and fanatical—we are prone to underrate the difficulties of intercourse in former times of more laborious travelling. In the early colonial period the colonies took little heed of each other. There was interdependence between a colony and the mother-country, but not between one colony and another. This was, perhaps, a consequence of the policy which was restriction on the commerce and manufactures of the colonies. It was, in a great measure, in accordance, too, with the feelings of the colonists, for *Old* England long had a place in their hearts; but what was *New* England to Virginia, or Virginia to New England? "*Home*" was the significant and endearing title which continued to be applied, with a permanence of habit that is

remarkable, to the mother-country. When the news of the great fire in London, in 1666, reached Massachusetts, subscriptions of money were made throughout the colony for the relief of the sufferers.

It appears, too, both from documentary history and from private correspondence, how limited was the intercourse between the inhabitants of the different colonies. In the biographies of men whose movements are of sufficient consequence to be traced and recorded, but few instances of the kind can be collected. Washington, in 1756, travelled as far eastward as Boston, and in the next year he visited Philadelphia; but both these visits were occasioned by peculiar demands of a public nature connected with the old French war—the first, for the purpose of a personal interview with the commander-in-chief, General Shirley; the second, to attend a conference of governors and officers, summoned by Lord Loudoun. These are, I believe, the only occasions, before the beginning of the Revolution, when he attended the Congress of 1774, that Washington went to the northern or middle provinces. Mr. Quincy's visit to the middle and southern colonies, immediately before the Revolution, was (as is obvious from the record of it) an undertaking of quite an unusual character; in 1773, writing home from Charleston, he speaks of "this *distant shore.*" No other instance occurs now to my recollection, except a visit to Boston of two of the Philadelphia patriots—John Dickinson and Joseph Reed—a few years before the war of independence. Even as late as the meeting of the first general Congress—that, I mean, of 1774—there is much, it appears to me, in the private letters and other contemporary evidence of that period which shows that when the delegates to that Congress assembled they came together very much as strangers to each other personally, and representing, too, communities strange to each other but finding more congeniality than they had anticipated.

In thus noticing individual intercourse, as illustrative of the times, there is one case, indeed, which I have not spoken of, because it is clearly *exceptional*, and must so be considered in judging of the personal intercommunication during the colonial period. I refer to the case of Dr. Franklin. Boston-born and Philadelphia-bred he had, no doubt, in consequence a less provincial feeling, a more expanded sense of citizenship, which was favored too by the course and opportunities of his remarkable career, his personal activity, and his official positions. No man had so much to do with various colonies; for, not to speak of his wanderings in boyhood, we find him, under his appointment in 1753 as Postmaster General for America, travelling in his one-horse wagon from Pennsylvania into New England. Again, in conference with delegates from seven of the colonies at the Albany Congress of 1754, busy at Boston with Governor Shirley, at Philadelphia with a Massachusetts commissioner, and all in quick succession; in Maryland acting as a sort of unofficial quartermaster for General Braddock; at a later period of colonial history, in England, uniting the agencies of Pennsylvania, Massachusetts, and Georgia. Now, although undoubtedly the formation of the Union is to be traced to causes of deeper import than any individual influences, I cannot but think that such various and extended intercourse as Dr. Franklin's must have aided in no small degree in bringing about that community of civ-

feeling which at length took the shape of political union. Sagacious, practical, affable, a man of the people in the best sense of the term, led by official duties hither and thither through the land, brought into business relations with the highest and the humblest functionaries, governors and generals and village postmasters, Franklin cannot but be regarded as an instrument imperceptibly and unconsciously doing the work of union. His case was, however, an exception to the ordinary intercourse among the inhabitants of the several colonies, and as an exception proving what we are apt to lose sight of, that the formation of the Union was a slow, a laborious, and reluctant process. *Happily* so, for thus it gained a strength which no hasty or premature coalition ever could have acquired. The period of transition from the original state of political severalty to the present political combination may be described as a space of time not shorter than a century and a half, making the computation from the first distinct effort at union, the original suggestion in 1637 of that little local coalition styled "The New England Confederacy," down to the Declaration of Independence, or, if a later date be preferred, when in 1789 the Union was made "*more perfect*" by the adoption of the present Constitution. During this long period the processes of combination were going on silently, imperceptibly, seldom thought of, and never fully appreciated; advances sometimes made, and then the cause retrograding; the power of attraction prevailing at one time, and the power of repulsion at another; connexion at one period looked to for security, and again shunned and resisted as concealing danger.

It is not without interest to observe that there was nothing in the physical character of the country, with all its variety of soil and climate, which presented impediments in the formation of the Union. There was no natural frontier at any part of the territory occupied by the settlements which were for a long time limited to the country extending from New Hampshire to Georgia, and bounded by the ocean and the first great range of mountains.

Rivers flowing north and south are thought to be most influential upon civilization, perhaps by connecting the climate and soil of different latitudes. When our territory was expanded to receive the whole valley of the Mississippi, we can look back to the long and difficult negotiations respecting the navigation of that river, when its banks were held by different powers, as indicating that Nature fitted it for a great highway for *one* people, and to bind them strongly together for ever.

No bay or river interposed a dangerous or difficult navigation; indeed, the great rivers, the Delaware, the Susquehannah, the Hudson, and the Connecticut, each flowing through the territory of several colonies, served by their free navigation to facilitate the intercourse of the colonists. There was no such mountain intersection as would cut off by a natural barrier one portion of the country from another, such as has been observed in Italy, where only a few years ago a Neapolitan naturalist, making an excursion to one of the highest of the central Apennines, found medicinal plants growing in the greatest profusion which the Neapolitans were regularly in the habit of importing from other countries, as no one suspected their existence within their own kingdom.

Looking to the physical character of the continent in relation to the

subject of social and political union, I may allude to another consideration as affecting our national progress and permanence. It has been observed by a distinguished French naturalist that mountain ranges which run east and west establish much more striking differences with regard to the dwellers on the opposite sides than those ranges which extend north and south, a statement confirmed by observation through the history of mankind. The Scandinavian Alps have not prevented the countries on both sides being occupied by a people of common descent, while the feeble barrier of the Cheviot hills and the Highlands has served to keep the Anglo-Saxon and the Celt apart even in a period of advanced civilization. The Spaniards and the Italians differ more from their neighbors across the mountains extending east and west than the former from the Portuguese, or the Piedmontese from the Provençals. Of this physical law of civilization and the destiny of races the most remarkable illustration is perhaps to be found in the separation, which continued through so many centuries of ancient history, of the races that occupied the northern coasts of the Mediterranean and the races that dwelt in Central Europe. There is no more remarkable fact in the history of mankind; and the barrier which so wondrously preserved this separation between populous nations comparatively so near to each other, was that east and west mountain range, which extends from the western extremity of the Pyrennees, at the shores of the Atlantic eastward, to the shores of the Caspian. It was a partition that remained unbroken by either the southern or the northern race, with rare and only partial exceptions, until at length the time arrived for those vast irruptions by which a new civilization was to take the place of the ancient and the Roman. The application of this law of Nature to our own race occupying this continent is manifest, and it is of momentous interest in connexion with the origin, the extension, and the perpetuity of the Union. The mountain ranges, great and small, extend in a northwardly and southwardly direction, but none in that direction which seems to have a power for partition over the races of men. It is only *conventional* lines running east and west that perplex the nation.

The physical character of the territory occupied by these colonies which where to become the thirteen United States, was favorable to the establishment of Union. Further, it may be regarded as favorable to the same result that during the colonial period no addition of territory took place which might have introduced an incongruous element, unmanageble material to be brought into union. In making this remark, I have especially in my thoughts the failure of Cromwell's plan for securing his then recent conquest of Jamaica by co-operation with Massachusetts in planting a New England colony there. The Protector's proffered gift of a West India island was declined by the practical good sense of the general court of the colony; and thus the community which was destined to grow in compact strength on their own soil was saved from being parted into two communities with the ocean between them. The interview between Cromwell and Leveret, the agent of the colony, as narrated by the latter in his despatch to Governor Endicott, (December 20, 1656,) is curiously characteristic on the one hand of that intense and deep policy which is part of the mystery of the Protector's cha-

racter, and on the other, of the keen, clear-sighted, common sense of the representative of the colony:

"At my presenting," writes Leverett, "your letter of the 1st of December, 1656, to his Highness, he was pleased to inquire of New England's condition, and what news as to the business of Jamaica; to which I gave answer according to the advice received. By his resent thereof, together with what I had from him the 18th November, he manifested a very strong desire in him for some leading and considerable company of New England men to go thither; for at that time he was pleased to express that he did apprehend the people of New England had as a clear a call to transport themselves from thence to Jamaica, as they had from England to New England, in order to their bettering their outward condition, God having promised his people should be the head and not the tail; besides that design hath its tendency to the overthrow of the man of sin; and withal was pleased to add, that though the people had been sickly, yet it was said to be a climacterical year; that others had been to view the place, as Nevis people, who, upon liking, were gone down; and Christopher's people were upon motion; and he hoped by what intelligence he had from Captain Gookin, that some considerable numbers would go from New England. His Highness was pleased to hear me in what I objected. As to the bettering our outward condition, though we had not any among us that had to boast, as some particulars in other plantations, of raising themselves to great estates, yet take the body of the people, and all things considered, they lived more comfortably like Englishmen than any of the rest of the plantations. To which his Highness replied that they were more industrious, what then would they be in a better country? To which I added, that there were now in New England produced to bespeak us a Commonwealth greater than in all the English plantations besides; the which his Highness granted. I objecting, the contrariety of spirits, principles, manners, and customs of the people of New England, to them that were at the island or on any other plantations that could remove thither, so not like to cement; his Highness replied that were there considerable persons that would remove from thence, they should have the government in their hands, and be strengthened with the authority of England, who might be capable of giving check to the ill and vicious manners of all."—(Hutchinson's History, Vol. I, p. 176.)

We need not now speculate what might have been the effect; a people who had this consciousness of *much that bespake them a commonwealth*, had they been tempted away from their own stern clime and soil to dwell in a tropical island; but of this we may be assured, when we look forward to the subsequent career of that people, that it was happily provided that they should remain compact at home.

In like manner at a later period of our history, all the efforts which at the beginning of the revolutionary struggle were made to bring the other British provinces into co-operation with the thirteen colonies proved utterly ineffectual. It will be remembered, that when the first general Congress met in 1774 and deliberated on plans of peaceful resistance to the obnoxious policy of the mother-country, it was a matter of solicitude to increase and fortify that resistance by enlarging the sphere of it. It must be borne in mind that all that was then aimed at

was colonial redress; to that, and not to independence did the first Congress direct its thoughts, its words, its action. The events of that time followed in such quick succession, leading so rapidly on to independence, and now seen to be so rapidly connected with such a result, that we are apt to forget that independent existence as a nation was not, for some time after the contest began, aimed at, or even desired. The heart of the people felt and avowed a sincere and natural reluctance to break away from an ancient allegiance. Thus contemplating a continuance of the colonial condition and not looking beyond it, the desire was to render colonial resistance as effective as possible, by bringing as large an amount of it as possible to bear on the ministry and parliament. Accordingly repeated exertions were made to induce all the colonies to make common cause. The Congress, composed at first of the delegations of twelve colonies, from New Hampshire to South Carolina, appealed to the other colonies, Nova Scotia, St. Johns, and earnestly and urgently to Canada. The addresses to these British provinces fill a large space in the journal of the first Congress. The hope was that all British America might be brought to think, feel, and to act in unison in a cause then regarded as a temporary one, simply colonial redress, the restoration of a former colonial policy with which the colonist was content.

And here let me remark in passing that this attempted policy of general colonial co-operation appears to me to explain both the use and the disuse of a term which for several years was a very familiar one, but afterwards became obsolete in our political vocabulary and for a long time has had only a historical significance. I refer to the word "*continental*" as employed both formally and familiarly in the titles "the *continental* Congress," "the *continental* Army," and in a phrase of less agreeable association "the *continental* Currency." The term was an appropriate one when it was meditated to make the colonial resistance co-extensive with the British communities on the continent; and such was the plan when the word came into use, and it passed into disuse when it was at length ascertained that such enlarged co-operation was not to be accomplished, but that out of the conflict there was to arise a new nationality not co-extensive with the continental extent of British power in America.

The second Congress, I mean that of 1775, clung to the same hope and the same policy of colonial combination on the most enlarged scale; and this feeling continued even after the beginning of hostilities. Again did Congress address to the non-participant provinces elaborate appeals and invitations; again did they communicate arguments to Canada to demonstrate the hidden perils of the Quebec bill, to show the superiority of the common law over the civil law, to expound religious toleration, persuading the French Canadian that Roman Catholic and Protestant might dwell together securely and harmoniously as in the cantons of Switzerland.

Nay, further, the Congress indulged the expectation of even more than cis-Atlantic opposition, for it sent its voice from Philadelphia across the sea to the people of Ireland. In the earliest scheme of confederation—that submitted to Congress by Dr. Franklin, in July, 1775—one of the articles expressly provided for the admission of Ireland,

the West India islands, Quebec, St. Johns, Nova Scotia, Bermudas, and East and West Floridas into the "Association," which was then relied upon as a means of colonial redress.

Besides the appeals and the invitations addressed to the Canadians, there was a hope that a successful invasion of Canada might bring the population there into that support of the common colonial cause for which the other means had failed. Accordingly, the expedition under Montgomery, in the winter of 1775–'6 had a purpose additional to mere conquest—that of gaining the support and the assistance of their fellow-colonists.

Still clinging to this object, Congress resorted to one other and the last attempt—an embassy to speak in person to the Canadian—the commission composed of Dr. Franklin, Charles Carrol, and Samuel Chase, taking with them for their coadjutors a Roman Catholic priest, the Rev. John Carrol, (afterwards archbishop of Baltimore,) and equally pacific agents, a printer and a French translator.

All these efforts—addresses made and made again, invasion, the embassy of commissioners—all proved utterly unavailing in bringing to those early Congresses any co-operation from other British provinces. The addresses were not responded to, probably were hardly heeded; the military expeditions failed, and the commissioners found no audience. The printer who accompanied Dr. Franklin and the other commissioners proved of no avail, in consequence of an unanticipated but fatal obstacle, and that was that reading was a very rare accomplishment with the French Canadian population. Quebec was not more impregnable to Montgomery than were the minds of the Canadians to Franklin and a printing-press.

These schemes for more extended colonial combination—began in 1774, continued during 1775 and into 1776—all came to naught; and now we can see, what was not visible to those who conceived those schemes, how happy it was that they *did* come to naught. I do not mean to question or to disparage the sagacity of those colonial statesmen, who during three years persevered in those schemes and the various methods of accomplishing them. Judged with relation to the objects aimed at, those schemes were wise and patriotic; but the objects were only *colonial* opposition, and the combination which was contemplated was only to be a temporary one, to cease whenever the colonial grievances should cease. But in God's government over the destinies of the race and country other and greater results were in reserve,—independence, nationality, union,—and considered with relation to such results, I repeat it was most happy that all attempts to bring about Canadian combination proved absolutely fruitless. It was only eleven years before, let it be remembered, that Canada had been transferred, by conquest and the treaty of Paris, from French to British dominion. A province so recently foreign in laws, in language, in the various social elements, must needs have proved an incongruous, if not a discordant member in such a union as was on the eve of completion between the thirteen colonies. The very fact that it was necessary for Congress to cause the addresses to Canada to be translated into French, is of itself enough to show how little congeniality there would have been for the perpetual purpose of union. When, therefore, Canadian

sympathy and co operation were invoked, "a wiser spirit" was at work to make that invocation of no effect.

While the addition of these incongruous materials was happily prevented, it must not be forgotten that the portion of the continent which was to be the soil of the Union already included within its bounds, indeed in its very centre, elements equally foreign and unsuited to natural combination; for almost contemporaneous with the settlement of Virginia and of New England, in the first quarter of the seventeenth century, Hudson's voyage had created the claim of Holland, and the grant by the States General to the Dutch West India Company planted their settlement along the banks of the Hudson. Thus was introduced into the very heart of the land a hostile element, for England and Holland were at strife in the East Indian commercial settlements, in which region, the massacre of the English traders, at Amboyna, occurred about the same period.

Another occupation, foreign, but less antagonistic, was that which connects with American history the name of one of the wisest and noblest of Europe's continental kings, statesman, and soldier, Gustavus Adolphus, of Sweden; a company of whose subjects settled, it will be remembered, on the banks of the Delaware.

Settlements such as these, by two of the great European powers, and on most important sections of the continent, were unpropitious to any progress of union among the British colonies, for the foreign and unfriendly occupation was interposed between the northern and the southern settlements, an occupation held too by one of these foreign powers for well nigh half a century, and during all that time ambitious of larger colonial dominion, and actively aggressive.

For the removal of these impediments to our union, there was needed the strong control of conquest. In one respect that process was simplified, as if the course of things was so guided as to leave behind as little as possible of the ill blood and rankling recollections of conquest. There was engendered no animosity between the Swedes and the English colonists; for it was Holland that did the work of conquest, and subjugated the little Swedish colony on the banks of the Delaware.

For England, there was, therefore, left only one colonial adversary; and the adverse element of a foreign occupation of a considerable and important part of the continent was done away by the result of the war between England and Holland; the treaty of Breda, and the final cession of the territory, thus establishing English colonial dominion in uninterrupted occupation of the whole extent of the country, which was thereafter to be in union.

It would, perhaps, not be easy now to measure the sense of repugnance which survived in the minds of the conquered Dutch colonists; the natural reluctance at the transfer, by conquest, of their allegiance; the compulsory identification with a people who had other laws and usages, and another language: but whatever these feelings may have been, they met soon with what must have been a most unlooked for alleviation in the course of events in Europe; for it was only twelve years after the Dutch colonists in America passed under British dominion, that their native country, Holland, gave a sovereign to Great Britain, and thus the throne of their conquerors was filled by one of

their countrymen, him who had been their Stadtholder, their Prince of Orange. Thus British rule became less of foreign rule to them; and thus the revolution of 1688 may be referred to as having contributed a harmonizing influence to the progress of the American union.

The Dutch dominion in America, adverse as it was to union in one respect, by parting the northern from the southern English colonies, in another respect exerted an influence favorable to colonial combination. It was not only the presence of hostile Indian tribes on the New England frontier, but it was also the neighborhood of the Dutch, "that prompted the first effort of colonial union; that of the united colonies of New England" which had its beginning in 1643, the first "confederacy," the first time the word "confederacy" was used in America. It was the first of these combinations, serving to show how it was a sense of common danger, the sense of strength and security in united action, which, by slow and safe gradations, was to bring the several colonies into union, disclosing, from time to time, how natural it would be for the sentiment of social union, which all the while, no doubt, however unrecognised at the time, was growing strong, to be converted into *political* union; how the sense of brotherhood, of a community of citizenship would imperceptibly prepare itself to assume political form and consistency.

I cannot pause to comment on that early confederacy, its principles, its system, and its uses. It purported to be "a *perpetual* league of friendship and amity," and it contained provision for its enlargement by the admission of other colonies into confederacy with the four colonies who were the contracting parties. Limited as this confederacy was in the number of its members, cautiously restricted as it was in its powers, and close and pressing as the dangers were, five years were consumed in the planning of it; *perpetual* as it professed to be, it lasted no more than about forty years; no other colony was added to it, and as the dangers which suggested it passed away, the confederacy lost its interest, and when its existence ceased incidentally with the abrogation of the New England charters, in the reign of James II, no effort was made to renew it. The old Saxon principle of distinctive local government was at work even within the narrow circuit of these kindred Puritan colonies, and no adequate motive for union presented itself. There are traces of mutual jealousies there; especially was there jealousy of the centralizing authority of Massachusetts. This feeling was manifest in the solicitude on the part of the Plymouth colony to preserve its separate existence. It breaks out in the bitter humor of a not very felicitous pun on the Bay colony, in a despatch from the Plymouth agent to the Plymouth governor, when, writing from London in 1691, he says: "All the frame of Heaven moves upon one axis, and the whole of New England's interest seems designed to be loaden on one bottom, and her particular motion to be concentric to the Massachusetts tropic. You know who are wont to trot after the bay horse."—(Wiswall to Hinckly, Nov. 5, 1691. Hutch. I, 365.)

In the New England confederacy, unanimity in religious creed was an essential principle of political concord, an impediment to the progress of union, if the confederacy had continued, for admission was refused to their dissenting fellow-colonists of Rhode Island. The Puri-

tan clergy who went to Virginia were ejected for non-conformity; and it was only about twenty years before William Penn obtained the charter for Pennsylvania, and came with his Quaker followers, that the "*Friends*" who ventured into New England were scourged under the law against "vagabond Quakers," and the sterner penalty of death inflicted.

If at an early period sectarian animosity was burning lines of division between the colonists, the now tolerant christianity of a later time contributed largely to the more accordant results of blending the communities together. Each christian society was at length enabled peacefully to commune with its own brotherhood in other sections of the country, and thus ecclesiastical sympathy became one of the means by which the way was prepared for civil and political sympathies. The inhabitants of different and distant colonies became members of one household in their faith, thus learning, perhaps, how they might become members of one political family. Among the churches of the church of England in the colonies, no ecclesiastical union in one collective representative assembly was formed until after the peace of 1783. The Presbyterians, feeling the want of ecclesiastical combination, as appears from a circular letter of the ministers and elders at Philadelphia, began in 1764 to take measures to effect a union of their scattered forces.

I turn now to another and very different influence of union, which is to be discovered in the military colonial combinations. On repeated occasions the authorities of the colonies—governors and commissioners—were brought into connexion for conference respecting hostilities, offensive as well as defensive. It was upon such an occasion, in 1690, at New York, that the word "*Congress*" first has a place in our history. But, besides such occasional conferences, the colonists were brought together in joint military service, to know each other the better thereby. This kind of association may be traced as an influence of union, more or less operative on different occasions from the times of what were called "King William's war," and "Queen Anne's war," at the close of the seventeenth and at the beginning of the eighteenth century, down to the peace of Paris, in 1763, at the end of the old French war. The colonies contributed their respective sums of money to the general cost of the war, and troops levied in the different colonies served together in the several early attempts on Canada, in the expedition against Cape Breton and the capture of Louisburg, and upon what was the first foreign service of the colonists, (I mean foreign beyond the continent,) Vernon's disastrous expeditions against Carthagena and Cuba. The associated service in the old French war was the latest discipline of the kind to prepare the colonies for the war of the revolution.

While such influences and others of a more imperceptible nature, which I cannot now pause to discuss, were working propitiously for union, there was a counter-agency produced by the indications of a desire on the part of the British government to adopt a different colonial policy, to substitute for "that wise and salutary neglect," which Mr. Burke afterwards commended, a more active control. In carrying out such a policy there would be needed more of union, not spontaneous, voluntary colonial union, but compulsory union, by the imperial power on the other side of the Atlantic. It was at the close of the seventeenth

century that William the Third formed the standing Council of the Lords Commissioners for Trade and Plantations, vested with new and centralizing powers of superintendence. There had been in the more arbitrary reign of James the Second indications of the same policy of more active colonial control; and it made itself manifest in the new methods of colonial administration, their policy and their plans, in one instance nothing less than a recommendation that "all the English colonies of North America be reduced (reduced, such was the word) under one government and one viceroy." The consequence of all this was, that union began to present itself to the thoughts of the colonists in the obnoxious light of a means of increasing the ascendancy of the royal prerogative; and they watched with perpetual vigilance every approach to combined action, to union avowedly or covertly compulsory, as something that was fatal to colonial rights.

The ancient Saxon element of distributed power was quickened into renewed activity during a long period of apprehension. When, in consequence of the suggestion of the Board of Trade and of the colonial secretary, the Albany convention was held in 1754, with its delegations from seven colonies, extending as far south as Maryland, the plan of union proposed by that Congress was, as is well known, rejected; although the war with France was imminent, and although the author of the plan was Franklin himself, a delegate from Pennsylvania. The several colonial assemblies detected too much of prerogative in the scheme of union, which had the singular fate of proving also unsatisfactory in England, because of the opposite objection of too little prerogative. Franklin was discouraged in his hopes of colonial confederation; and one of his correspondents said to him, writing from Boston, in 1754: "However necessary a union may be for the mutual safety and preservation of these colonies, it is certain it will never take place unless we are forced to it by the supreme authority of the nation."

It was by the action of the supreme power of the nation that union did take place, but not in the way contemplated when those words were used. When the new and obnoxious colonial policy took the well defined shape of the Stamp Act, union, which had been dreaded when the proposal came in any form from the British government, was instinctively resorted to as a means of defence and security, and the delegations of nine colonies, as far south as South Carolina, met in the Congress of 1765.

When, nine years later, the power of the British government struck, with the Boston Port Bill, at one single point, the sentiment of union was discovered to be strong enough and quick enough to make common cause with almost instantaneous rapidity, and twelve colonies (soon afterwards to reach the full complement of the old thirteen) assembled by their delegations in the Congress of 1774. When it is considered that those delegations were chosen in various ways, with much of irregularity, of necessity, I know of nothing so remarkable in the history of representation as the meeting of those fifty-two men in a room of a building familiar to Philadelphians as the Carpenters' Hall, locking the doors, enjoining secresy on the members, and all the while the people from New Hampshire to Georgia waiting quietly, willingly, resolutely, prepared to do, I will not say the *bidding* of that

Congress, but to accept the conclusions of that Congress as the voice of the nation. What higher proof could there be of the unknown strength of union? I say the *unknown* strength of the sentiment of union, because that Congress contemplated nothing more than "*association*" (as it was termed) in a policy of non-importation and non-exportation. When the Congress of 1774 adjourned, it was a *contingent* adjournment, leaving it to be determined by the course events might take whether the colonies would again be found acting in concert. The plan of confederation proposed by Franklin in 1775 looked to no duration beyond the continuance of the obnoxious acts of Parliament; and even after the war began, and the continental army was formed, perpetuity of union appears not to have formed part of the plan of operations. It was not until the wearied patience of the people was worn out, and the aggrieved sense of freedom driven to the last resort, that the coalition of the colonies began to assume the aspect of permanence. Then, and not till then, it became apparent what had long been the tendency of things touching the relation between those distinct communities. Together they had sought redress for their grievances; together they had declared their rights; they appealed, petitioned, remonstrated together; and when they encountered the same repulse and the same disappointment, they "*associated*" under solemn pledges, "the sacred ties of virtue, honor, and love of country," for a combined pacific resistance. At length, when all had failed, and they saw that the hour had come for the last appeal, they bowed down together in "public humiliation, fasting, and prayer," and, with hearts thus fortified, they stood prepared to face the common danger. It was one war to all. Blood was soon shed; and that blood, poured out for the common cause of all, was the seal of union. Further, when hostilities had been continued for more than a year, and it became manifest that the war was ineffectual as a means of mere colonial redress, the process which established national existence was at the same time the consummation of union. The colonies, which found themselves in a state of revolutionary anarchy, instead of hurrying to separate action, deliberately sought the advice of the whole country as it might be given by Congress. They sought and they followed that guidance. This was union. When the final and formal act of independence came, it was done by all and for all. That was union. Therefore, there is, I think, no proposition in our constitutional history clearer, simpler, truer than this, that *Union is our country*.

In conclusion, permit me to say, that I fear I have exposed myself to some condemnation for rashness in attempting to treat so large a subject within such limited space. I have had it most at heart to show how, during a very long period of time, there has been a tendency of events proving a providential purpose in the establishment of the Union. However the feelings of men may differ in respect for antiquity, what mind can refuse to recognise a claim for all that can be given of thoughtful, affectionate, and dutiful loyalty to that which for our good was achieved by more than human agency working through centuries. For the *Constitution* of the United States you may carry your debt of gratitude to the memory of that assembly of sages and statesmen who in convention constructed the Constitution. The debt of gratitude for

Independence may be paid to that other assembly of wise and good men who declared it. But for the UNION, our thanksgiving must be laid at the foot of the throne of God; and therefore treason to the Union cannot be conceived of but as a crime which heaps upon the traitor an accumulated guilt of thankless impiety. I speak it with reverence and with humility, and with thoughtfulness in the words I use, when I say that this Union of ours was the work of God.

LECTURES.

VI.—ON METEOROLOGY.

BY ROBERT RUSSELL, ESQ.,* OF SCOTLAND.

First Lecture.

To study the peculiarities of the atmospheric changes in North America, and the effects of the climate on agriculture, are the principal objects for which I have visited this part of the world. I am much gratified to find so large a number of meteorological observers scattered over all parts of this vast continent, contributing so materially to the advancement of science.

Since I have had an opportunity of studying the meteorology of the United States, I have been much impressed with the limited area of the field for investigations within the British islands. It now appears as a mere handbreadth, in comparison to the wide territory over which you are prosecuting your inquiries into the causes of atmospheric disturbances.

Your government has done considerable for the support of meteorology. It has accumulated at the National Observatory, under the direction of Lieutenant Maury, an invaluable collection of facts relative to the sea. It has established observations at each of its military posts, and has secured the services of Professor Espy, who has done more for theoretical meteorology, in my opinion, than any other living man.

But I must confess that I would have turned my face to the Old World somewhat unsatisfied, if I had not had, through the politeness of the Secretary, an opportunity to examine the meteorological records collected within the walls of this Institution, and, through them, to become acquainted with the peculiarities of your climate; and to trace out the nature and extent of some of the atmospheric disturbances which had attracted my attention during my tour.

In this short course of lectures I shall not enter upon those questions which relate to general meteorology, but shall confine myself principally to the analogies which seem to subsist between the action of atmospheric agents in Europe and in North America, and point out a few facts which demand more extended observations for their solution.

*Note.—The author of these lectures came to this country with letters of introduction from Sir David Brewster, Professor Airy, and other distinguished cultivators of science in Great Britain. The Smithsonian meteorological records were opened for his investigation, and other facilities extended him for the prosecution of his studies. Without intending to endorse the peculiar views which he may have advanced, we may say that his lectures contain facts and suggestions fully worthy of attention. J. H.

To comprehend the nature of the changes which the atmosphere undergoes, the elementary principles of meteorological science must be understood; but I do not intend to enter more minutely into these than will enable those who have not devoted much attention to the subject to comprehend the more important truths.

The nature of the atmosphere was long involved in obscurity. Its properties could not be ascertained till chemistry and other branches of natural science were considerably advanced. Air has so little color that it is almost invisible, and offers so little resistance to motion, that it was considered by the school of Aristotle imponderable. This opinion was entertained for many centuries afterwards, until the invention of the barometer, by Toricelli, in 1640, and the discovery of the fact pointed out by Pascal, that the barometer stands lower on the top of a mountain than at its base, left no doubt remaining that air was possessed of weight, and, consequently, that the atmosphere exerted a great pressure.

If a glass tube, three feet in length, be filled with mercury, and its open end inverted in a basin of the same liquid, the mercury in the tube will stand, at the level of the sea, nearly 30 inches higher than the surface of that in the basin. This column of mercury, which, if its section is a square inch, weighs nearly 15 pounds, is balanced by a column of air of the same section and extending to the top of the atmosphere. The pressure of the atmosphere is, therefore, equal to that of an ocean of mercury of 30 inches deep, or to a pressure on each square inch of surface of about 15 pounds. Moreover, mercury is 13½ times heavier than water, and 10,500 times heavier than dry air at the surface of the earth; hence the pressure of the atmosphere is equal to that of an ocean of water of about 33 feet deep, or an ocean of air, of equal density throughout, of 27,000 feet high.

That the atmosphere should press on the surface of the earth, and on all parts of our bodies, with a weight of 15 pounds to the square inch, is, at first sight, a very perplexing fact; but it is fully illustrated by the familiar and analogous pressure of water. The diver who descends below the surface of the sea is pressed on all sides by the superincumbent weight of water, and, instead of being incommoded by this, is rendered more buoyant. The particles of the air are of extreme tenuity and of almost perfect mobility, and therefore offer no resistance to bodies moving among them. On these accounts the weight of the air, and the great pressure of the atmosphere, remained so long concealed.

For a long time after the discovery of the pressure of the atmosphere, the world remained in ignorance of its chemical and mechanical constitution. The analysis of air was, however, one of the first triumphs of modern chemistry. Rutherford discovered hydrogen, one of its components, in 1772; and, two years after, Priestly and Shiel, independently of each other, discovered the other principal ingredient, namely, oxygen.

Dry air is composed of 77 parts nitrogen, 23 oxygen, by weight; 79 parts nitrogen, 21 oxygen, by volume; carbonic acid, 1.1000 by weight; ammonia, only a trace. The atmosphere also contains a certain amount of moisture. This is the only component which is liable to

much change in its quantity. It varies from two per cent. to an inappreciable portion.

Again, the chemical composition of air had been established several years before its mechanical character was fully made out. The sages of Egypt and of Greece disputed about the constitution of matter; but their speculations, however ingenious, led to no definite results. At the end of the last century many valuable facts had been accumulated on this point; but no great law had been proposed to link these facts together before JOHN DALTON applied the atomic theory of the constitution of matter to explain the mechanical phenomena of the atmosphere.

Dalton did much for chemical science, and is justly regarded as the father of meteorology. He was gifted with gigantic powers of mind, and, in other respects, possessed a noble character.

Modern science regards matter as made up of atoms endowed with attracting and repelling force. In the case of a solid or liquid, these two forces are in equilibrium—the atoms are held at a distance from each other, and do not fill all the space enclosed within their boundaries. If a solid or liquid is subjected to pressure, the atoms are made to approach each other, and the repulsion is increased; so that, when the pressure is removed, the atoms fly back to their original position. If, on the contrary, we attempt to draw a solid apart, the attraction comes into operation, and offers a resistance which is called cohesion. In the case of aeriform substances, the repulsion entirely preponderates. Dalton gave to this theory a definite form, and applied it to the phenomena of the atmosphere.

All our conceptions of the constitution of substances, in regard to their solid, liquid, or aeriform states, are more or less intimately associated with the atomic constitution of matter in its relations to heat. Thus, the action of heat converts a solid into a liquid, by giving mobility to its atoms. The action of heat converts a liquid into an elastic vapor, or gas, by imparting a repulsive force to its atoms. Indeed, in regard to gases, the repulsive force and heat are often looked upon as identical, and we shall consider them to be so. The elastic properties of gas, steam, or vapor, are, then, owing to the mutual repulsion of the atoms, in consequence of the action of heat. This view, arising naturally out of the atomic constitution of matter, gives an explanation of the mechanism of gases no less simple than consistent.

To illustrate this principle one fact will suffice. If water is converted into steam under the ordinary pressure of the atmosphere, a cubic inch is transformed into about a cubic foot of vapor. The atoms of water are, therefore, twelve times further apart in the case of steam than they are in that of the liquid. The action of heat has had the effect of putting every atom in a state of repulsion with regard to its fellows—every one tends to fly from the other with as much force as if each was under the influence of a powerful spring. The intensity of the repulsion of the atoms constitutes the force of the steam. The elastic properties of the gases of the atmosphere are also owing to the mutual repulsion of their atoms, though the repulsion is much more permanent in this case than in that of steam. No cold or pressure has yet been found sufficient to reduce nitrogen or oxygen to a liquid form.

The bulk of gas is increased by heat, which must not be looked upon as increasing the size of the atoms, but only as increasing the repulsive force between them. The repulsive or expansive force is measured by the weight which it can support. In the atmosphere, the expansive force of a portion of air, or its elasticity, is exactly balanced by the gravity of all the air above it. The weight of the atoms, from the top to the bottom of the atmosphere, amounts, as we have said before, to about fifteen pounds on each square inch; the elastic or repulsive force which keeps the atoms apart is exactly equal to this amount. Gravity and elasticity are so equally poised, and the atoms move so freely amongst each other, that the air is in a state of the most delicate balance that can be imagined.

The expansive property of gases is a remarkable phenomenon in physics. We have no means of ascertaining its limits, but we know if the whole air was exhausted from this room, a single cubic inch of either oxygen or nitrogen would, if admitted into so large a vacuum, instantly occupy every part of it, and still press, though with diminished force, against the walls for further expansion. The repulsive force which exists among the atoms, though greatly weakened, would not be exhausted.

The law which regulates the density and elasticity of gases was discovered about half a century after Toricelli invented the barometer. Mariotte found, by experiment, "That the density and elasticity of atmospheric air are directly, but the space it occupies inversely, as the force of compression." That is to say, if you exhausted the air from the receiver of an air-pump until the barometer stood at fifteen inches, the pressure or elasticity of the air would only be half of what it was before the experiment. It would take two cubic inches of air in this state of rarity to weigh as much as one did when the barometer was at thirty inches; or, in other words, one half of the atoms being removed, the remaining half are further apart, since they still occupy the same space. The number of atoms being reduced one half, if the temperature is the same, their repulsive force is also reduced in the same ratio, and, therefore, the repulsion of the particles of any gas increases as the cube root of the distance between them diminishes. The repulsion between the atom at the very top of the atmosphere and those below it is so much weakened by separation that it is precisely equal to the weight.

From the simple fact that the repulsion of the atoms of gases varies as the number of atoms contained in a given space, it follows that the elasticity and density of a gas are as the pressure directly, that the volume is as the pressure inversely, and that, consequently, the one can be deduced from the other by the simple rule of proportion. This law holds true in regard to the most minute additions of weight, and we have the full assurance of reason, founded on experiment, other things being equal, that the distance which separates every atom of air from the top to the bottom of the atmosphere decreases as we descend; in short, each atom is nearer the atom immediately below it than the one above. The various strata of the atmosphere thus in some measure resembles fleeces of wool or loose balls of cotton piled upon each other. The wool or cotton is more compressed, and therefore more dense, in proportion to the weight it bears; it is most so

next the bottom, and least so at the top. The air, in the same way, is more rare as we ascend to greater heights, the atoms being farther apart, and their repulsive force diminished. In consequence of the great capabilities of gases for expanding with diminished pressure, the atmosphere, instead of being only about five miles in height, as it would be if of equal density with the lowest stratum, (?) is really upwards of fifty miles high.

The atmosphere is not only in a most delicate state of balance in respect to elasticity and pressure, but it is no less so in respect to the amount of heat contained in its different strata. The expansive force of gases, or the repulsion which exists among their atoms, seems, as we have already stated, to be identical with heat. When air, at the temperature of freezing water, is condensed in the hollow globe of an air-gun, an immense amount of heat becomes sensible. Tinder, it is well known, can be lighted with a single stroke of a condensing syringe. In the rarefied gas a large amount of heat is stored away and inappreciable by our instruments or senses, which is again given out by compression.

The intimate connexion subsisting between heat and the expansion of gases is most beautifully seen in the atmosphere. As already stated, the atoms of air as we ascend are at greater distances from each other. If the distance between any two atoms is diminished, they give out heat or render it sensible; whereas, if we increase the distance between them, they store it away. The upper strata are sensibly colder than the lower, not because the atoms have less heat, but because the heat is diffused through a larger space when the atoms are farther apart. One pound of air at the level of the sea, within the tropics, may be said to contain no more heat than the same weight at the top of the highest mountain perpetually covered with snow. It is for this reason that the same wind which is warm in the valley becomes colder as it ascends the sides of the mountain. The diminishing pressure allows the air to expand and store away its heat. It is, therefore, not the snow on the top of mountains which cools the air, but it is the rarity of the air which keeps the snow itself from melting. As a general law, the decrease of temperature amounts to 1° Fahrenheit for every 300 feet in perpendicular height.

A variation in the amount of heat affects the volume of a gas as sensibly as a variation in the pressure. An addition of heat increases the repulsive force of the atoms, and thus expands the volume. All gases, reckoning from the freezing point of water, expand nearly the 480th part of their bulk for every degree of temperature; or, in other words, if one cubic foot of air had its temperature raised 480° above the freezing point, its elastic force would be doubled, or it would tend to expand to twice its former bulk.

If a number of atoms of air in the lower stratum receives a greater amount of heat than those in the vicinity, they will repel each other to a greater distance apart than they were before they were heated, and will have a tendency to ascend, on the same principle that a piece of cork rises in water.

On these undisputed data Dalton founded his two famous conditions of atmospheric equilibrium, which are now regarded as the true basis

on which all atmospheric disturbances are to be studied. First, that the atmosphere can only remain in a state of rest or equilibrium when the barometer stands at the same height at the level of the sea in all parts of the globe, because the aerial envelope has a tendency like water to seek its equilibrium. Second, that the atmosphere must every where have the same temperature at the level of the sea, and that its various strata as we ascend must have a temperature corresponding to their position—that is, that every atom, from the top to the bottom of the atmosphere, must possess the same absolute amount of heat.

A number of natural agencies are at work to disturb the equilibrium of the atmosphere, and to give rise to aerial currents; among them the most important is the difference of temperature in different parts of the earth. The air within the tropics, constantly heated by the rays of an almost perpendicular sun, is rendered lighter, and is pushed upward by the heavier air north and south of this region. A current in this direction from each pole is thus produced at the surface of the earth, while an opposite current towards each pole is generated by the rarefied air which rises above the heated belt, and flows backward like water seeking its equilibrium. These currents, on account of the rotation of the earth, are not along the meridian, but those at the surface take a westerly direction, while those above flow in an easterly course. This is the origin of the trade winds at the surface of the earth, and of the great westerly current which is almost constantly moving in the upper strata over the middle and northern portions of the United States. That such a current does prevail over the regions mentioned is clearly proved by Professor Coffin's admirable report on the winds of the northern hemisphere, published in the Smithsonian Contributions to Knowledge. The phenomenon of the constancy of this upper current early attracted my notice in my tour through this country, and I learn from the records that it is the same all the year. The fact of the existence of this current is referred to by President Dwight, in his History of New England, to explain some atmospheric phenomena; and, indeed, it is one of the keys to a knowledge of the peculiarities of the meteorology of this country.

To understand some of the peculiar actions which occur in the lower strata of the atmosphere, it is necessary for us to consider a little more attentively the effect which sometimes takes place when a large area is slowly heated and the air above it gradually expanded. In this case the heated air, increasing its volume and resting on the surface of the earth, pushes up the air above it, and thus retains it in a state of unstable equilibrium. This condition was observed by the French savans as existing over the heated sand of the desert, and giving rise to the mirage. It was also observed by Colonel Sykes, on the plains of Hindostan, and is quite common in all latitudes.

This is a very unstable condition of the atmosphere, and is constantly liable to be overturned; yet its philosophy is not difficult to comprehend. When the atoms of air in the lower stratum are gradually and equally heated, all have a tendency to rise, and the cold atoms above have a tendency to descend. But as there is not room for all to descend and all to ascend at the same time, there is little downward or upward motion.

This is a very simple principle, but it is the only one which enables us to comprehend how a dead calm often exists immediately before violent storms, and even before the tremendous hurricanes of the West India islands. A large amount of power is in this way held in reserve ready to be developed under various circumstances. We shall mention some phenomena as illustrations which are produced in this way.

The unstable condition of the air, which results from the undue heat of the lower stratum, produces those great whirlwinds of dust and sand in the deserts of Arabia and Africa. The air flows in beneath, and revolves as it ascends, carrying loose material with it. Humboldt, when crossing over the great plains of South America during the hot season, recorded a curious instance of the effect of the sun's rays on the surface of the ground when the air was calm: "In the Mesa de Paja," says that illustrious traveller, "we entered the basin of the Llanos. The sun was almost at its zenith; the earth, wherever it appeared sterile and destitute of vegetation, was at the temperature of 86° to 90° F.; not a breath of wind was felt at the height at which we were on our mules; yet in the midst of this apparent calm whirls of dust incessantly arose, driven on by these small currents of air which glide only over the surface of the ground, and are occasioned by the difference of temperature between the naked sand and the spots covered with grass."—(Personal Narrative, Vol. 1.) The land and the sea breezes observed in warm countries are caused by somewhat similar agencies. The land in the day time becomes heated to a much greater degree than the sea; the air over the former expands and flows away above, while the comparatively cold air from the sea rushes over the land. This is exactly reversed at night, the air over the sea being slightly warmer than over the land—the breeze is from the latter. All are agreed as to the general cause of this phenomenon, but I am inclined to think the particular mode of action has not received that attention which it deserves. As I shall have occasion to show that the action of the sea breeze in Great Britain apparently furnishes us with the true principle upon which certain violent disturbances sometimes take place over one half of Europe, I shall be a little particular in describing the exact mode of action. And I am not singular in opinion that a modification of the same principle applies to some of the storms of the United States. On a recent visit to Cuba I had an opportunity to study some well defined instances of land and sea breezes. I was particularly interested in the former, because I was less familiar with them from personal observation; for while the sea breeze is common in summer on the east coast of Scotland, the land breeze is very rare. Hugh Miller has given a description of the sea breeze in his work entitled "My School and Schoolmasters," as it occurs on the Cromarty coast, which is well worth a perusal by those who take an interest in such matters.

The particular summer sea breeze of North Britain, so far as I have had an opportunity of observing, only occurs when an upper current is flowing from a westerly quarter. This condition seems to be essential to its action. The breeze is always strongest on the coast, it gradually moderates as it passes into the interior, and finally dies away long before it reaches the west coast. The manner in which the sea breeze loses its force shows that it is gradually absorbed into the upper current,

and that it does not rise in one vertical column, but that there is a constant ascension and absorption going on over the whole extent agitated by the breeze. By way of exemplification, and to render my exposition more clear, I shall direct your attention to the action which takes place between soft and salt water, at the mouths of large rivers. Captain King observed a current of salt water running up the mouth of the Santa Cruz, beneath the fresh water. In this case we cannot for a moment imagine that the salt water rises in a body at any particular spot, and returns as salt water to the sea; but only that the salt under current is gradually absorbed into the fresh stream above, at every point as far as the salt water extends.

Now suppose the sea breeze has a depth of 2,000 feet, and extends 50 miles into the interior of the country; it will not rise in a vertical column of 2,000 feet in width, but will be gradually absorbed, by rising in small portions into the upper current along the whole distance traversed. The greater depth of salt water at the mouth of the river corresponds to the greater velocity of the air on reaching the land. The spot where the breeze is not felt has its counterpart in that point of the bed of the river where the salt water ceases to flow against the stream. The deep upper current from the southwest, which overlies the shallow sea breeze, performs the part of the large body of fresh water of the river, to which the other phenomena are merely secondary. The power which propels the salt water up the bed of the river is the difference in the weight of the fresh and salt water. In the sea breeze, the air over the surface of the land is lighter than that over the sea at the same elevation; and it is this difference in the weight of the two columns of air which, in this case, is the propelling power. If the barometer was sufficiently delicate, the rate of motion of the breeze might be calculated with considerable precision.

The heat of the sun materially affects the force of the winds at the earth's surface in all parts of the world. The still air of evening is well known to be in striking contrast with the breeze of midday. During the night the air cools more rapidly next the ground than at a greater elevation. The ascending currents cease with the heat of the sun, and friction soon induces a calm.

At the meeting of the British Association for the Advancement of Science the year before last, I took occasion, in illustrating the action of one class of storms which agitate the atmosphere of Europe, to point out the fact that the sun, during the summer months, in North Britain, had the effect to reverse the motion of a thin stratum of air at the surface of the ground; while, *during the day*, a north current constantly flowed above and a south current flowed below, *during the night* the latter was reversed. I have found similar phenomena to prevail in the United States. For some days, in Charleston, last January, I observed that the wind was south during the heat of the day, and north in the morning. I cannot stop now to discuss the cause of this phenomenon, though it is exceedingly interesting in a scientific point of view. But there is an analogous effect produced, upon a grand scale, east of the Rocky mountains, over the United States, as well as the British Possessions, that requires to be noticed in this place. It has been most satisfactorily made out by Professor Coffin, that southerly winds, in North America, are much

more common in summer than in winter; the following are his reductions:

Between lat. 32° and 33°, 9 stations, 8 year's average: S. Carolina, Georgia, Alabama, and Mississippi.	Jan., N. winds, 3.06.	— S. to W.S.W.	7.77 days.
	July, N. winds, 1.83.	— S. to W S.W.	10.16 days.
Delaware, Maryland, and Eastern Virginia.	Jan., N. winds, 2.81.	— S. to W.S.W.	6.29 days.
	July, N. winds, 1.05	— S. to W.S.W.	13.00 days.
New England States south of latitude 45°, 49 stations, 5 years.	Jan., N. winds, 3.55.	— S. to W.S.W.	6.60 days.
	July, N. winds, 1.44.	— S. to W.S.W.	15.74 days.
Between 45° and 50° latitude: Iowa, Wisconsin, Michigan, Canada, and Maine, 10 stations, 17 years.	Jan., N. winds, 4.17.	— S. to W.S.W.	5.73 days.
	July, N. winds, 1.83.	— S. to W.S.W.	10.77 days.
Total north wind.....................	19.74	Total south wind.	76.06

I quite concur in the opinion, first entertained by Volney, that the summer south winds of the United States are chiefly supplied from the trade winds of the tropics. To this wind is to be ascribed the amazing fertility of the climate for sugar, cotton, Indian corn, and tobacco. The isthmus which connects North and South America is too high to allow the trade winds to cross into the Pacific ocean; and in summer they appear to be frequently directed northwards by this great natural wall, and find their way across the Gulf of Mexico, and spread out as a surface current loaded with moisture over the Mississippi valley and the eastern seaboard States. If the isthmus which connects the two continents had been sufficiently low to allow the trade winds to cross into the Pacific, the valley of the Mississippi would have had, in all probability, a much less productive summer climate, resembling that of the south of Europe or the north of Africa.

I may here mention that there is only an extremely limited area in Europe which has sufficient summer rains, with the requisite temperature, to grow Indian corn, and that there are no cotton or sugar regions. The summers of Spain, except on the northwest of the country, are usually so very dry that little Indian corn can be grown without artificial watering. The productive powers of the soil are almost entirely centred in the valleys, which are irrigated by the melting of the snow of the mountains.

The summers of Italy are also too dry, and the melting of the snow on the Alps is essential to the fertility of Lombardy. The largest and best region for Indian corn in Europe is in the south and east of France. Mr. Marsh, in his introductory lecture here, told us that for three months rain did not fall in summer at Constantinople. In Palestine, "rain in summer" is still as rare as the "snow in harvest." In the valley of the lower Nile, a shower of rain is a remarkable phenomenon; the overflowings of the river serve for the growth of wheat, but no Indian corn or millet can be had without laborious irrigation; accordingly, fifty thousand oxen are employed in summer to draw water for this purpose. In upper Egypt no crops of any kind are obtained without the same appliance; and during a low current in the river the peasants are obliged to raise the water upwards of forty feet. When we reflect on these facts, the great fertility of the summer climate of North America, east of the Rocky Mountains, is very surprising. The aridity of the Mediterranean shores is owing to the prevalence of northerly winds; while the fertility of the United States is owing to the prevalence of those

from the south. This statement is amply supported by Professor Coffin's researches in the Smithsonian Contributions.

The warm surface wind which sets in from the Gulf of Mexico over the United States, is not only the great source of fertility, but is also the great disturbing element of the atmosphere at all seasons of the year. During the warm season, in this country, when the wind changes to north or northwest, the sky becomes peculiarly transparent and blue in color. I have frequently had occasion, in my tour through Canada and the United States, to observe that the lower south and southwest wind begins to blow, as in Great Britain, shortly after the sun heats the air at the surface of the ground, and that the sky soon loses its peculiar transparency. One point in regard to this surface wind from the south deserves special notice. I allude to the fact that it is often at rest or very sluggish during the night, and most active during the maximum heat of the day. This vast surface wind which spreads over the region east of the Rocky Mountains, and over the Gulf of Mexico, is therefore daily put put in motion by the heat of the sun. The short time which I have been able to devote to this subject leads me to believe that the breeze begins to stir at an earlier hour in the day in the higher latitudes, and that it is gradually propagated to the south. The sun rising earlier the farther we advance northward is probably the cause of this phenomenon.

Mr. Thom, in his work on the "Nature and Course of Storms," p. 255, informs us that south and southwest winds prevail during summer over the projecting shoulder of South America, at Guiana; and I was informed by the sugar-planters that in Cuba south winds are common during the rainy season, namely, May, June, July, and August. Mr. Phelps, also, in a recent communication to the meteorological department of the Smithsonian Institution, mentions the fact that at Fort Brown, on the Rio Grande, the prevailing winds are from the south, or probably a point or two to the east of south. This, he says, is more particularly the case during spring and the earlier part of summer, when they are usually pretty constant, especially during the day time, blowing at the rate of fourteen miles an hour, or five degrees of latitude per day. But Professor Coffin's report, already alluded to, gives us the best view of this great aerial current, which flows over the Mississippi valley, as well as along the Atlantic slope.

The two great systems of atmospheric currents, viz: the lower and warm surface wind from the south, and the cold and dry current flowing constantly in the upper regions from the west, are intimately associated with all the changes of the weather in the United States. But before we attempt to trace the nature of these changes we must direct attention to another element of meteorology, which we have as yet almost left out of view, viz: the elastic and invisible vapor of water contained in the air, and which plays so important a part in almost all atmospheric changes.

Science, as we have seen, was long perplexed with the problem of the manner in which water existed in the air; sometimes entirely invisible, at others obscuring the heavens with clouds, or falling as rain or snow. For the solution of this question, we are also indebted to John Dalton, who gave an explanation of the matter, no less simple than consistent and ingenious. He at the same time opened up a new

view of the mechanism of mixed gases, gave us new ideas of the constitution of the atmosphere, and enabled us to comprehend the agency which "divides the waters of the firmament from the fountains of the deep." The hygrometry of the atmosphere will be considered in our next lecture.

METEOROLOGY.

Second Lecture.

That water placed in an open vessel over a fire does not have its temperature raised above 212 degrees, however great the heat may be, and that the steam produced is no warmer, is among the first of the wonders which arrests the attention of the student entering upon the field of physical science. The heat of the fire is absorbed in the production of the steam. The atoms of water are made to repel each other. A cubic inch of this liquid converted into steam at 212 degrees, at the ordinary pressure of the atmosphere, has its bulk increased nearly 1,700 times. The elasticity of the steam thus produced is equal to the weight of a perpendicular column of 30 inches of mercury. This must appear quite evident when we consider how steam is formed. It rises from the bottom of the vessel which contains the water, in bubbles, and can only be rapidly formed when the repulsion of the atoms is able to resist the whole weight of the incumbent atmosphere.

Dalton, however, discovered that vapor is formed at all temperatures; that the boiling point of water and the elasticity of the vapor are entirely regulated by heat and pressure. This he proved by allowing a small quantity of water to ascend to the top of the mercury in a common barometer tube, where it produced vapor, the elasticity or pressure of which could be exactly measured by the height of the column, as the heat was increased or diminished. This simple experiment showed that the connexion between the temperature, density, and elasticity of steam is subject to the same physical law which regulates the density and elasticity of the permanent gases. The following exhibits a few cases of steam at different temperatures, with the corresponding force and weight:

Temp. 0°;	force	0.068	in inches;	weight of cubic foot,	0.856	grains.
20°	"	0.140	"	"	1.688	"
40°	"	0.280	"	"	3.239	"
60°	"	0.560	"	"	6.222	"
80°	"	1.060	"	"	11.333	"
212°	"	30. 00	"	"	257.218	"

In fact, after allowing for the difference of the temperature in steam, according to the law which holds in reference to other gases, the pressure of steam at any low temperature being given, the weight of a cubic foot of steam can be calculated by the simple rule of proportion.

Steam or vapor, at all temperatures, may be considered as water containing a definite amount of heat. A pound of steam at 212° contains very little more caloric than a pound of vapor at 32°. This is proved by the fact that steam, at any temperature, when condensed, is capable of raising the temperature of its own weight of water more than 1,000°. If a cubic foot of steam at 32°, weighing 2.539 grains, were subjected to pressure, and none of the heat evolved during the condensation lost, a small volume of steam at 212° would be produced. But a cubic foot of steam at 32° could not exist in the atmosphere by itself, as it would be subjected to a pressure of 30 inches of mercury, whereas it could bear no more than one-fifth of an inch. Hence a difficulty arose amongst chemists in regard to the manner in which water existed in the invisible form in the atmosphere at all temperatures, and under all pressures. There was also some difficulty in accounting for the manner in which the mixture of the different gases took place.

It has been found that air brought down from the tops of the highest mountains, and from the greatest elevation reached by aeronauts, is nearly the same in composition as at the surface of the earth. This fact was rather perplexing, because the different gases of the atmosphere have not the same specific gravity. A cubic foot of oxygen weighed more than one of nitrogen, while one of carbonic acid was 50 per cent. heavier than either.

Common air	1.0000
Carbonic acid	1.5240
Nitrogen	0.9760
Oxygen	1.1026
Steam 212°	0.6235

The carbonic acid being the heaviest gas, it should chiefly occupy the lower stratum of the atmosphere; and the nitrogen the top. Dalton, to reconcile a variety of phenomena with each other, added a new proposition to the theory of the atomic constitution of the mixed gases—namely, that the atoms of oxygen do not repel the atoms of nitrogen, but only those of their own kind. That the one gas is as a vacuum to the other. On this principle the most complete mixture of gases is explained, the atoms of one gas by their mutual repulsion are forced apart as is in void space, and thus diffused among those of another. At the last lecture we mentioned that if this room were completely exhausted of air, and a cubic inch of hydrogen introduced, it would instantly expand and fill the whole space. Now, the same thing would happen if a cubic inch of hydrogen were introduced into the room filled with air. The process would be much slower, but the mutual repulsion of the atoms of hydrogen would still be in as active operation as it was in the vacuum, and would still cause them to separate until they pressed against the walls of the room with as much force as if there were no air in it.

Not only has the truth of this law been verified, but the diffusive velocity of the various gases ascertained by actual measurement. This velocity is inversely as the density of the gases; in other words, the lighter the gas the greater its rapidity of diffusion. The vapor of water, or steam, is subject to the same law; and this is the solution of

the difficulty we mentioned as to its capability of existing in the atmosphere at all temperatures. In accordance with this law, the atoms of water, as well as those of the several gases which compose the atmosphere, are as far separate from the atoms of their own kind as they would be if each alone occupied the space. The pressure of the compound atmosphere is therefore made up of the joint pressures of the individual gases.

Strictly speaking, vapor is not condensed by the pressure of air, but by diminution of temperature; and the amount of moisture which can exist at any time in the atmosphere depends upon the amount of heat. Air saturated with moisture may be likened to a vessel filled with round shot or sand. The spaces between the atoms of the permanent gases are occupied by the atoms of steam, in the same way as water fills up the vacant spaces between the shot or sand. The atoms of water are at a distance when steam at any temperature is by itself, and they can possess no greater repulsive force than is due to the temperature of the evaporating surface. Pressure applied to the atoms will cause condensation, if the heat arising from this act is lost. This is the same in the moistest atmosphere—the atoms of water are at a distance, and their repulsive or diffusive force is the cause of their remaining invisible. Evaporation, therefore, in the atmosphere at a given temperature, can only take place when the atoms of water are removed as far from those on the evaporating surface as they would be in pure steam at the same given temperature.

Air is said to be saturated with moisture when as many atoms of vapor are contained in it as would exist in a vacuum at the same temperature. The atoms of air merely fill up the interstices of the elastic vapor of water, or the converse. If the temperature be diminished, the repulsion of the atoms will not be sufficient to support so great a pressure, and a part of the vapor will be condensed into water. The reduced temperature at which this condensation begins to take place is called the dew point, or point of precipitation.

The elastic force of vapor would ultimately cause it to rise to the top of the atmosphere by virtue of this repulsive or diffusive property, if it were not checked by other causes. At one time meteorologists attributed many atmospheric phenomena to the great activity of the diffusive power of the vapor of water; but we are indebted to Professor Espy for showing that this has been very much overrated, and other agents are the more active causes.

The air has its temperature raised during the day by the direct heat from the sun and contact with the earth, and loses the greater part of this heat during the night by radiation into space. The ground radiating heat much faster than air in a clear, calm night, is generally cooled down below the point of precipitation of the vapor, and thus condensation of moisture is produced and dew formed. This effect of radiation has a most beneficial influence on vegetation. The formation of dew is regulated by a very simple law, viz: that *the dewed surface is always colder than the air in contact with it.* In the same way the dew-point of the air is ascertained by cooling down any body until moisture is formed upon it. Several hygrometers have been formed on this principle.

The amount of moisture in the atmosphere has a great influence in modifying the heating power of the sun's rays, as well as in the radiation of heat during the night into space. We often find two days in summer equally free from clouds and equally calm, while the one may be oppressively warm, and the other comparatively cool. This does not arise from a difference in the power of the sun's rays, but from the quantity of moisture in the atmosphere.

The influence of moisture in tempering the sun's rays is a remarkable fact and well worthy of further investigation. When the dew point is high, or, in other words, when the air is filled with moisture, the radiation from the earth is prevented, and the temperature of the night remains almost as high as that of the day; when the dew point is low, the sun's rays pass, without absorption, to the earth, and impart little of their heat directly to the air. The medium dew points are, therefore, most favorable to extreme heat in the atmosphere, and the greater heat beyond the tropics is probably owing to this cause.

The fact that the amount of moisture in the air regulates the temperature of the nights has not received the attention which it deserves. I shall hereafter show that the hygrometrical condition of the atmophere throws a very considerable amount of light on the action of North American and European storms; and therefore I am more anxious to draw your particular attention to the relation between the dew point of the vapor of the air and the night temperatures, because this is the only means which I have of indicating the hygrometrical conditions connected with the storms of the United States.

It seems to be a law which holds in general over the world that the temperature of the air at sunrise during calm nights, at a certain distance from the ground, falls a little below the dew point of the air during the preceding day. The mean temperature of the air at sunrise, therefore, approximates very closely to the mean dew point. The great amount of moisture in the air within the tropics is the cause of the warm and brilliant nights. Radiation from the air and ground, under these conditions, seems to lose its power. On the other hand, travellers in all parts of the world inform us, incidentally, as to the connection between dry air and cold nights. Mr. Inglis, in his travels through Spain, relates that he was oppressed by the hot rays of the sun in the valley of Granada while the hoar frost was lying white in the shade. Eastern travellers in the deserts often complain of the broiling heat of the air during the day, and of its chill temperature at night. Beautiful allusions to the same law are also found in Scripture; many of you will recollect that one of the greatest hardships which Jacob experienced while he tended Laban's flocks was, that through the "drought by day and the frosts by night sleep departed from his eyes." On the other hand, the moisture from the Atlantic in summer allows the air to retain its heat in the valley of Chamouni, in Switzerland, so that grapes ripen in the immediate proximity of the glaciers which descend from the Alps. At Bergen, in Norway, the same element allows the cherry-tree to mature its fruit where you can pluck it and throw the stones upon the broad mass of ice which slowly descends from the mountains.

Those days during summer in the United States on which the sky

is very transparent are rather deficient in moisture. The air is then somewhat bracing, as the sun does not have the power of heating it up to a high degree. The great changes in the weather which take place at all seasons over the United States, and the very cold winters in comparision to those of Europe, are intimately associated with the hygrometric condition of the atmosphere, which we must now consider.

Why are the winters so cold at Washington in the 38° of latitude, the same as that of Lisbon, in Portugal, where the orange-trees are now in blossom? This is owing to the great prevalence of west and northwest winds, which are very dry, and sweep over the vast territory from Canada to Florida, and are converted into the northern of Cuba and the coast along the Gulf of Mexico. President Dwight, a most accurate observer, in his Travels and History of New England describes the character and effect of the winds so accurately, that I will quote two short passages. He says, "In 1787 the west wind began to blow about the 20th November, and continued its progress with only four short interruptions until the 20th of the following March—somewhat more than 100 days. During the whcle time the weather for the season was very cold." Also, "in 1780 the wind blew from the west more than six weeks without any intermission, and during the whole of this time the weather was so cold that snow did not dissolve sufficiently to give drops from the southern eaves of houses." So long as the westerly wind continues to blow in winter there is no cessation of your cold, and so long as it continues to flow in a broad regular stream in summer there is no end to your drought. President Dwight maintains that the west and northwest wind is merely the descent of the upper current which flows so regularly right across the Rocky Mountains. Whoever will take the trouble to examine the meteorological observations within the Smithsonian Institution, I am inclined to think, will come to the same conclusion. If the south wind was as common in winter as in summer, and if there was no descent of this upper current, your winters might be as mild as those of Portugal, which are tempered by the moist wind from the southern Atlantic.

The question naturally arises, why is the west wind so extremely cold? The answer is, simply, because in crossing the Rocky Mountains it is robbed of its moisture; and becoming so dry that the sun pours down his rays of heat; in vain neither the air by day nor the ground by night can retain them; they fly off into space. The principle on which air is dried in passing over high mountains is a very simple one, if we merely bear in mind that air expands under diminished pressure and becomes colder by the heat being diffused over a greater space. Professor Espy has very ably investigated this subject on theoretical grounds. But, as our space is exceedingly limited, I shall merely adduce some examples by way of illustration. Mr. Walsh made an ascent in a balloon on the 26th August, 1852, from Kew Gardens, in England. The barometer stood at 30 inches, and the dew point was 61°; or, in other words, the air contained 6,06 grains of water in every cubic foot. At the height of 18,370 feet the barometer stood at 15 inches, temperature of air 70, dew point 2°8, or equivalent to 0.8 grain of water in a cubic foot. But at this elevation the air being expanded

by the diminished pressure, two cubic feet will only weigh about as much as one did at the surface of the earth. Two cubic feet, therefore, would contain 1.6 grains of water. Now, it will be evident, if this upper air was to descend to the surface of the earth, it would have its temperature raised by coming under increased pressure; but its dew point, as will be seen by inspecting a table, would be no higher than 23°, instead of 61°; the radiation during one night would, therefore, cool down the air at the surface of the earth to this temperature. The dry upper current coming over the Rocky Mountains often descends to the earth in winter, and is the cause of the severe weather at that season in the country east of these mountains. The great westerly current of air from the Pacific in passing over the Rocky Mountains, and in ascending their westerly slopes, becomes colder by expansion, and, consequently, deposits its moisture. It is true the heat liberated by the condensation of the vapor will tend to elevate the temperature of the air on the top and at the foot of the mountain above its nominal point; but this effect is counteracted, as we have said, by the increased freedom the dry air gives to the radiation of heat from the surface of the earth and the lower stratum of air, particularly when it is spread over a wide extent of radiating surface. The descent, therefore, of the dry and upper current of westerly winds to the surface of the earth is, I think, the principal cause of the sudden and extreme changes of weather in this clime. President Dwight states that in the month of July, 1804, considerable snow fell at Salem, in New England, and that a severe frost was experienced in different parts of the same country. In all parts of the world where moist winds, or those from the ocean, blow over high ranges of mountains, they deposit their moisture in the form of rain and snow on the windward slopes. This is the case on the coast range of Oregon and California, and also on the slopes opposite the prevailing moist winds in South America.

In England not more than 23 inches of water falls annually in some of the level eastern counties during the year, while nearly 200 inches occasionally fall on the western side of the mountains of Cumberland. The west wisds of Norway are remarkably mild and rainy for such a high latitude, while the same winds in Sweden are comparatively cold; the air, in losing its moisture on the high chain of mountains, loses its power of retaining the large amount of latent heat extricated by the condensation of vapor.

The production of cold through expansion is the cause of clouds resting on the tops of mountains when they should apparently be borne away on the breeze. The precipitation of vapor as the air rises on the one side, and the evaporation of it as the air descends on the other, is the true cause of the phenomenon. The formation of clouds in the sky and precipitation of moisture are chiefly produced, as Mr. Espy has demonstrated, by the ascent of comparatively moist and warm air from below. The expansion produces cold, and of course the precipitation of moisture into clouds and rain. The cumulus clouds of summer are thus formed by ascending currents of moist air. The condensation of the vapor extricates a large amount of latent heat, which expands the air within the cloud, and thus produces an increased buoyancy. Before thunder-storms the air is usually moist and oppressive, the perspiration from the skin is checked by the moisture,

feels warmer on this account than it really is. The temperature within this cloud being higher than that on the outside in consequence of the evolution of latent heat, the passage of a thunder-cloud over any place almost invariably disturbs the air at the surface of the ground. The extrication of heat is a motive power which constantly causes the air to ascend in the front of the storm as the cloud drifts along in the upper current. Squalls are produced in the same way. Professor Espy, in his Report on Meteorology, says: "Low clouds are constantly forming in the front of squalls by the upward motion of the moist air as fast as their hinder parts are swept down by the falling rain, and thus they appear constantly just in front of the squall, for it is only in front that there is an up-moving column of air from below."

We shall enter a little more particularly into this subject, to show the analogy between these isolated disturbances arising from the formation of cloud and precipitation of rain and the land and sea breezes, hurricanes of the West India islands, thunder storms of America and Europe, and also some of the great snow and rain storms of both continents.

In Humboldt's celebrated voyage from Europe to South America he relates that, on reaching the latitudes of the trades, the "wind fell gradually the further we receded from the African coast; it was sometimes smooth water for several hours, and these short calms were regularly interrupted. Black, thick clouds, marked by strong outlines, rose in the east, and it seemed as if a squall would have forced us to haul our top-sails; but the breeze freshened anew, there fell large drops of rain, and the storm dispersed. Meanwhile it was curious to observe the effects of several black, isolated, and very low clouds which passed the zenith. We felt the force of the wind augment or diminish progressively according as small bodies of vesicular vapor approached or receded. It is by the help of these squalls, which alternate with dead calms, that the passage from the Canary islands to the Antilles or southern coast of America is made in the months of June and July."

From this description we gather that there was an upper current prevailing from the east, in which the clouds drifted, bearing them over the calm air resting on the ocean. The air in front of the cloud is disturbed as soon as the cloud approaches, and a violent squall prevails so long as it is overhead. This shows the intimate connexion between the upper and lower currents of the atmosphere when clouds are passing.

Unless clouds were constantly replenished by vapor from below, it is physically impossible that they could continue to throw down such great quantities of rain over long tracts of country as they are sometimes known to do. At no time, even within the tropics, is the air over one spot capable of precipitating more than three inches of rain.

In the squalls described by Humboldt we observe that there was calm both before and after the passage of the cloud. The motion of the air at the surface of the sea is much the same as if the whole portion of it under the cloud were in a state of vertical rotation around a horizontal axis. You will perceive that there is a resemblance in the motion of the air under isolated storm-clouds to that of the air in land

and sea breezes. The latent caloric evolved by the condensation of vapor is the moving power in this class of phenomena, and the difference between the temperature of the land and the sea is the disturbing force in the other. I have frequently attempted to show that many of the European storms were to be ascribed to a modification of these principles. Since reaching Washington it has been pointed out to me by Professor Henry that Professor Mitchell, of North Carolina, gave in Silliman's Journal a similar explanation of some of the American storms as far back as 1831. I had never seen this paper, and was a little surprised to find so great a similarity in our views, more especially as he had actually selected the same passages I have quoted from Humboldt as a common starting-point. But I have since found that Volney more than half a century ago accounts for one American snow-storm on the same principle.

I must, in the first place, draw your attention to a feature which appears to be common to the hurricanes of the West India Islands, and to the local squalls in the region of the trade winds, viz: that there is usually a calm before these terrific disturbances of the atmosphere. All who have examined these meteors are of opinion that the current above is from the southeast, and bears the hurricane clouds over the still and highly heated air; this being surcharged with moisture is in a most unstable state of equilibrium, which is liable to be overturned by the slightest cause that conspires to produce an up-moving volumn of air. To illustrate this I will merely read to you Captain Marryatt's graphic description of the coming on of a West Indian hurricane as given in "Peter Simple:" "What a hot day this has been; not a cat's paw upon the water, and the sky all of a mist. Only look at the sun, how he goes down, puffed out to three times his size, as if he were in a terrible passion. I suspect we shall have a land breeze off strong. The heat was excessive and unaccountable, not the slightest breath of wind moved in the heavens or below; no clouds to be seen, and the stars were obscured by a sort of mist: there appeared a total stagnation in the elements. We had not pulled long before a low moaning was heard in the atmosphere, now here, now there, and we appeared to be pulling through solid darkness; I looked, and dark as it was, it appeared as if a sort of black wall was sweeping along right towards us. The moaning gradually increased to a stunning roar, and then at once it broke upon us with a noise to which no thunder can bear comparison. The sea was perfectly level, but boiling and covered with a white foam, so that we appeared in the night to be floating on milk."

Professor Mitchell, in the paper to which I have already referred, expresses the opinion that thunder storms must be much less grand and imposing in Europe than in America, because poets have not considered them worthy of particular attention. Shakspeare, however, has not neglected our thunder storms, and with his usual philosophical discrimination has portrayed some of their more important peculiarities:

> "We often see, against some storm,
> A silence in the heavens, the rack stand still,
> The bold winds speechless, and the orb below
> As hush as death: anon the dreadful thunder
> Doth rend the region."—*Hamlet.*

The formation and progress of thunder storms are very peculiar in

this country. We have already alluded to the frequency of south and southwest winds over the United States in summer. These currents, derived, as we have said, from the trade winds of the tropics, contain a large amount of moisture, and are the source of the great fertility of the Mississippi valley. Extensive rains and thunder storms only occur after the south wind has prevailed for some time. I am inclined to believe that this vast aerial current, which flows below the upper westerly current, is much deeper in the southern than in the northern States. Mr. Phelps's observations, near the mouth of the Rio Grande, show that in his district the thunder clouds drift in the southeast current; and I have been informed that they follow the same direction in Louisiana and Alabama. But in the higher latitudes, as for example that of Washington, the thunder clouds all move in the direction of the upper current from a point or two north or south of west. The moisture which forms these clouds is no doubt derived from the lower stratum, whose upper surface is exposed to the erosion of the upper current, constantly sweeping a portion away towards the Atlantic. The action of the lower moist current rising into the upper and forming cloud, and perhaps part of the upper descending, is no doubt the principal propelling power of the surface wind. President Dwight gives a very good description of the thunder storms of New England, and refers to points which should be specially borne in mind. On one occasion he says: "The meridional line upon which I stood was crossed by the storm several miles to the south. During the whole day the wind had blown from the south, and continued to blow in the same direction on the surface throughout the afternoon, without a moment's intermission. But had the wind," says he, "which carried the cloud when it passed over the meridian swept the surface, the wind for a time, at least, must have been entirely stopped. This, however, was not the fact even for a moment." On another occasion, in 1809, a "thunder storm passed over New Haven, from the northwest, with great rapidity. It continued, as I judge, from an hour to an hour and a half. But though the clouds moved rapidly to the *southeast*, a *southwest* wind blew the whole of that day and *while the thunder storm was overhead with great violence.*"

The increase in the strength of the southwest wind, as the clouds drifted overhead from the northwest, shows that the lower and upper currents mixed together; that as in the case of the squall mentioned by Humboldt, a part of the lower stratum of air rising formed cloud, and that a part of the upper stratum descending to the earth was carried away by the prevailing surface wind from the southwest. This propelling power, I think, cannot be doubted in thunder storms; but I imagine the same principle must be taken into account as a source of motion to the southwest surface winds whenever clouds form in the sky and drift in the upper current. Thunder squalls drifting from the west, as I am also informed by Professor Espy, often draw in the stratum of air from the east immediately above the earth's surface; while the falling rain under the clouds forces the air outwards towards the east, and it rises immediately before the rain, carrying up dust and other materials. A slight westerly breeze then usually springs up and follows the cloud just a little in the rear.

In fact, from the very irregular nature of the winds of the lower

stratum, we must in general look for a local cause of propulsion, on the same principle that the motion of the air at the surface of the earth, during the day in summer, with clear and dry weather, is constantly varied by the heat of the sun at every spot over which the breeze passes. As soon as the warm southerly wind begins to blow as a general surface current over the United States, the conditions necessary to the production of a storm already exist. The southerly wind, often veering about very irregularly, will then frequently continue in the same direction, until the whole country from the Gulf of Mexico to Canada is covered with a comparatively hot and moist stratum of air. Under these circumstances a crisis must ensue, when the upper current from the Rocky Mountains resumes its sway at the surface of the earth. In winter it often sweeps the stratum of moist air from over the United States into the Atlantic, and completely changes the character of the weather in a very short time. In summer the changes are generally much less marked; for Professor Coffin's researches show that the northerly winds then lose their power. At this season the process usually takes place in a gradual manner. Thunder clouds, drifting in the upper current, as described by Professor Dwight, shower down their watery contents over the land, and thus enable Indian corn to be successfully cultivated over a surface of country vastly greater than in any other part of the world. How these effects are brought about, involves the whole question of the action of storms east of the Rocky Mountains. We shall leave, however, the further discussion of this for the present, and conclude this lecture by one example, showing the scale upon which thunder storms are sometimes developed much about the same time over a vast area of country. I am only sorry that my time has not permitted me to analyze this storm in all its details.

During the first days of last September the wind was mostly from the south; the weather became excessively hot and oppressive; the newspapers in all parts of the country were recording the high temperatures; when, on the 6th, thunder storms took place nearly simultaneously in Iowa, Illinois, Indiana, Ohio, Pennsylvania, New York, East and West Canada, and the New England States. Large quantities of rain fell in various parts of the country, as the storms were in several places somewhat locally developed. At some points the northwest upper current reached the surface of the earth for a time, the southwest wind again blowing as before, until a general change of wind to the northwest prevailed, and caused a great fall in the temperature. At Saratoga the thermometer stood at 96° in the shade on the afternoon of the 6th, and at 46° on the morning of the 9th at Rochester. It is a fact worthy of attention that a severe storm, amounting to a hurricane, swept the southeastern coast of the United States just about the time that this great change was taking place in the north and west. It is certainly well worthy the investigation of American meteorologists to ascertain whether any connexion exists between the weather in the northwestern States and the hurricanes of the West Indian islands, for in this instance the coincidence of phenomena was quite remarkable. As will be seen from our next lecture, great changes occurring in the northwest are rapidly propagated to the southeast in the case of winter storms.

METEOROLOGY.

Third Lecture.

When northwest winds prevail over the United States in winter, the air is very dry and cold; so long as the wind remains in this quarter there is no termination to the cold weather. It does not moderate, at least the thermometer does not rise, until the moisture is increased. I suppose it is admitted by meteorologists that the cold spells of weather in the United States are first felt in the west and northwest, and gradually extend over the country to the southeast. This direction, it will be observed, corresponds very nearly with the course of the current, which is so constant in the upper stratum of the atmosphere in this region. But it is a curious fact, well worthy of the attention of meteorologists, that the warm and moist surface air which precedes storms and cold weather travels also from northwest to southeast; at all events, it apparently does so. Sometimes a belt of moist air, several hundred miles in breadth, and extending from the mouth of the Mississippi to the lakes, and probably much further north, seems to advance from the west, while there is very cold weather both behind and in front of it. The storms of February, 1842, described by Professor Loomis in the Transactions of the American Philosophical Society, were of this character. On the morning of the 10th November last, similar phenomena were presented: the eastern portion of the Mississippi valley, and all the States south of the lakes and west of the Alleghany range, were under the influence of a comparatively moist and warm stratum of air, at the very moment that the temperature was about 20° lower from latitude 35° to 45° on the Atlantic seaboard, and between the same parallel of latitude in the western States west of longitude 92°. By the night of the 10th November, the weather became very moist and warm in the Atlantic seaboard States, more so than it had been in Ohio the previous day.

The moisture which was found in the broad band could not originally have come from the west, northwest, or north, because these winds are always exceedingly dry; nor could it have come from the Atlantic ocean, because the weather remains cold on the coasts when it is much warmer in Ohio. Indeed the storm was at hand before the east wind set in, and this is a usual occurrence. There can be but little doubt, therefore, that this moisture is originally derived from the Gulf of Mexico, and that it is spread over the middle and eastern portion of the United States by the southerly current, which, as we have before remarked, is, in our opinion, a deflected portion of the trade winds.

In a former lecture, I pointed out the fact, abundantly proved by Professor Coffin, that these southerly winds prevail more in *summer* than in *winter*; and an important point here suggests itself for future discussion. I think it very probable that a broad band of southerly winds,

extending across the country from Florida to Texas, may flow northward and gradually diffuse itself as a surface current over the valley of the Mississippi and the seaboard States. The sun heating the earth more at the north, during the longer days, assists in the propulsion of this current. The higher portions of this lower current are in contact with the under surface of the cold upper current from the west, and in the mingling of the two the moisture of the former is precipitated into clouds or rain. In some cases the lower current may thus be gradually absorbed into the upper one, and this action may take place over a considerable portion of the country, producing an extended cloudiness and perhaps a general fall of rain without violent atmospheric disturbance.

In winter, the propulsion of the southerly winds is not favored by the heat of the sun; at this season, therefore, they do not extend to so great a breadth as in summer, and only flow over the northern regions in streams, forming narrow belts of warm and moist air, to which we have just adverted. This warm current is often bounded by cold air, on the east and the west. The cold air on both sides is drifting from west to east, the warm current between (flowing from south and southwest) is also carried laterally to the east; and hence, the moist and warm weather of winter has an apparent motion from west to east.

Our inquiries relative to this point lead us to believe that the south and southwest winds in winter may begin to blow over Texas and the high ground a little to the east of the slopes of the Rocky Mountains, and cause a rise of temperature to the west of the Mississippi, when the northwest wind is still blowing dry, cold, and clear, over the whole of the middle and eastern States.

This, however, does not continue long; the west, northwest, and north winds soon descend between the western edge of the southern current and the mountains, and gradually force the former eastwards. On these occasions the north or northwest wind is the predominant one, which, rushing along the slopes of the mountains to the south, forms the well known northers from Vera Cruz to Cuba. According to this view, the norther should be felt sooner at the former place than at the latter. This much is certain, that almost every cold spell of weather which is experienced in the United States during winter is propagated to Cuba in the form of a norther, which, though the thermometer seldom sinks it below 55° at sunrise, is disagreeably felt by the inhabitants of the island.*

* Since this lecture was written, I have had occasion to examine an interesting series of "Queries and Strictures," by Dr. Hare, in regard to Mr. Espy's Meteorological Report. The view which we have taken of the northers in the Gulf of Mexico will, as far as it goes, answer in the affirmative Dr. Hare's 20th query, page 5:

"Whether northers are not consequent to the displacement of the warmer air lying on the Gulf by the colder air of the territory of the United States north or northeast (northwest?) of the Gulf, to whatever cause that displacement may be due?"

Among the number of interesting points suggested by Dr. Hare for discussion, an answer to the following queries we consider would contribute much to the advancement of the meteorology of the United States:

"5th. Wherefore, in one of Mr. Espy's generalizations, he alleges that storms travel from *west* towards the east during the five winter months, instead of alleging that they travel from northwest to southeast, consistently with the observations of Loomis, above mentioned?"

"7th. Whether there is not another distinct kind of storm, long known and universally recognised as the 'northeaster,' or 'northeastern gale,' which has been distinguished from the southeaster, so called by its direction, its longer endurance, lesser violence, and by its not being usually followed, after a brief lull, by a northwester, nor any violent wind in a direction directly opposite to that in which it blew at the beginning of the storm?"

On no question has there been more discussion among meteorologists than that in regard to the cause of the fluctuations in the height of the barometer, especially during storms. John Dalton made the following remarks on this subject more than sixty years ago; and they are well worthy of consideration in the present day, particularly since we possess better opportunities of ascertaining their truth:

1. "The barometer," says Dalton, "has little variation within the tropics; while within the northern temperate zone, and doubtless within the southern also, its range increases in going from the equator. The mean annual range at Paris, for twenty years, was 1½ inches; the greatest range, or difference between the highest and lowest observations, for the same term, was 2 inches. At Kendal, the mean range for five years was 2.13 inches, the greatest range was 2.65 inches. In Sweden and Russia the range is still greater.

2. "In the temperate zones the range and fluctuations of the barometer are always greater in winter than in summer.

3. "The rise and fall of the barometer are not local, or confined to a small district of country, but extend over a considerable part of the globe, a space of two or three thousand miles in circuit, at least.

4. "It appears that the mean state of the barometer is rather lower than higher in winter than in summer, though a stratum of air on the earth's surface always weighs more in the former season than the latter.

5. "F. Laval made observations for ten days together upon the top of St. Pilen, a mountain near Marseilles, which is 960 yards high, and found that when the barometer varied 2¾ lines at Marseilles it varied 1¾ inches, upon St. Pilen. Now had it been a law that the whole atmosphere rises and falls with the barometer, the fluctuations in any elevated barometer would be to those of another barometer below it nearly as the absolute heights of the mercurial column in each, which in these instances were far from being so. Hence, then, it may be inferred that the fluctuations of the barometer are occasioned chiefly by a variation in the density of the lower regions of the air, and not by an alternate elevation and depression of the whole superincumbent atmosphere."

I am quite aware that some of the deductions of Dalton require to be a little modified. His first proposition, however, that the range of the barometer increases in going from the equator towards the poles, is amply borne out as a general law by observations in this country as well as in Europe.

His fifth proposition is also correct, viz: that the fluctuations of the barometer are occasioned chiefly by a variation in the density of the lower regions of the air, and not by changes in the whole superincumbent atmosphere. To illustrate this, I will state a hypothetical case. In the balloon ascent made by Mr. Walsh, alluded to in a previous lecture, it was found that the barometer stood at 15 inches at the height of 18,370 feet. If the whole air below this elevation had been occupied by hydrogen gas, which is much lighter than common air, being only about one fifteenth of its weight at the same pressure, this lighter gas, possessing as much elasticity as common air, would be able to bear up the upper stratum of the atmosphere, weighing 15 inches of mercury; but at the surface of the earth the barometer would fall

about 14 inches below its ordinary height. Now it is easily seen that if the warm and light wind from the southward, which blows with so much regularity in summer, were as light as hydrogen gas, with the same elasticity, it would cause an immense fall of the barometer along the whole of the Mississippi valley when it displaced the cold air which has come over the Rocky Mountains. The southerly winds from the Gulf of Mexico are much warmer and lighter than those which have poured down the eastern slopes of the Rocky Mountains, and been cooled by radiation on the plains to the east. Consequently when they displace these colder winds in the valley of the Mississippi, a fall of the barometer ought, to a certain extent, to take place. I am, therefore, of the opinion that the fact of the displacement of the warm and moist current from the Gulf by the colder air from the west and northwest is sufficient to account for the fluctuations of the barometer, in a great many instances, in places to the west of the Alleghany chain of mountains.

Professor Espy informs me that he has traced a central line of minimum pressure, which precedes the eastern storms on the Atlantic coast first in the western States. This line is of great length from north to south; and from an examination of his charts of the weather, in his Report on Meteorology, I was at once struck with the fact that its direction corresponds with the trough of the Mississippi valley, and with the course of the moist winds from the Gulf of Mexico. In Europe, I have often been enabled to trace the connexion between the fluctuations of the barometer and changes in the temperature and moisture of the air; but I have never found the connexions so regular and intimate as in the Mississippi valley, which is more removed from influences which tend to disturb this action.

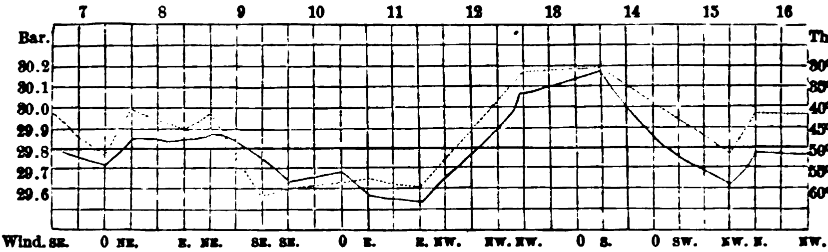
In my last lecture I showed that the temperature of the air at sunrise is, as a general rule, a close approximation to the dew point. A high dew point, or, in other words, a large amount of vapor, has the effect, as we have before said, of maintaining the warmth of the air during the night.

The observations collected by the Smithsonian Institution give the temperature at 7, A. M., and 9, P. M. As a rise or fall in the temperature at these hours may be considered as indicating an increase or decrease in the amount of moisture in the air, and as the fluctuations of the barometer are also given for the same hours, I have, therefore, in the diagrams, [figures 1, 2, 3, 4,] shown the connexion which exists between the heat and moisture of the air and the changes in the pressure.

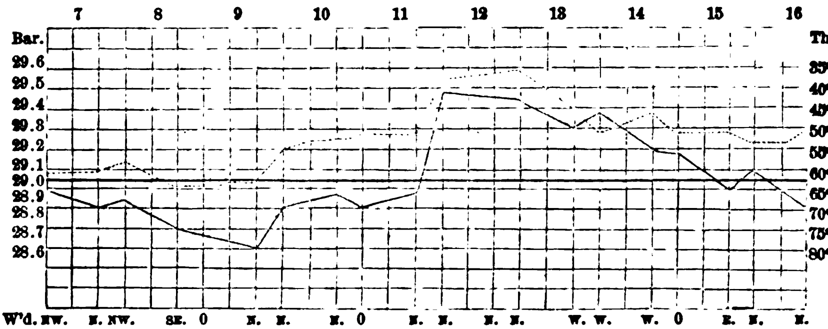
I have compared the temperature taken at 7, A. M., and 9, P. M., leaving out the day temperature altogether. The temperature at these hours, as I have stated, is a close approximation to the dew point. And this fact, which, as a general rule, holds true, especially in autumn, is the only means I possess to ascertain the hygrometrical state of the air during the storms of this country. The amount of vapor is an essential element in the investigation of atmospheric disturbances, and hence even an approximate estimate of the quantity is important.

The following curves of temperature and pressure of the atmosphere for 7, A. M., and 9, P. M., from the 7th to the 16th of November inclusive, are intended to illustrate the connexion between the moisture, temperature, and pressure, during a storm:

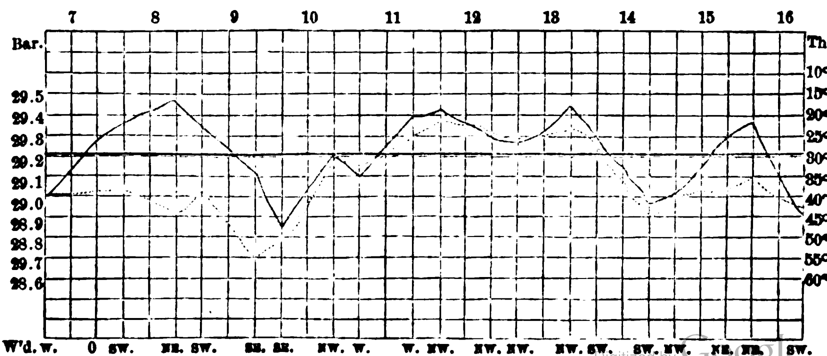
No. 1—*Curve of temperature and pressure for Tuscaloosa, Alabama. Latitude* 33° 12′ *N.*; *Longitude* 87° 12′ *W.*



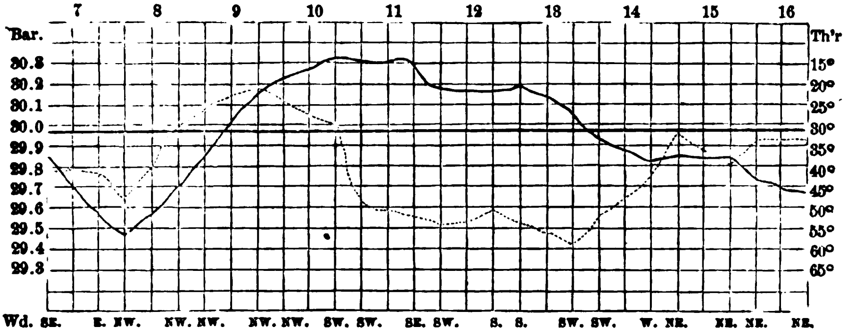
No. 2—*Curve of temperature and pressure for New Weid, Texas. Latitude* 29° 42′ *N.*; *Longitude* 97° 0′ *W.*



No. 3—*Curve of temperature and pressure for Milwaukie, Wisconsin. Latitude* 43° 3′ *N.*; *Longitude* 87° 57′ *W.*



No. 4—*Curve of temperature and pressure for Steuben, Washington county, Maine. Latitude 44° 44′ N.; Longitude 67° 50′ W.*



The continuous line represents the changes of the barometer, and the dotted line those of the thermometer. The figures on the left-hand margin of the wood-cut indicate heights of the barometer in intervals of one-tenth of an inch, and those on the right hand side, of the thermometer in intervals of five degrees of Fahrenheit's scale.

The figures along the upper margin indicate the days of the month during which the storm continued, and the letters along the lower the direction of the wind during the same time.

In order to exhibit more strikingly the relation of the temperature, moisture, and pressure, the dotted line is inverted so as to represent the highest point of the thermometer by the lowest point of the curve. With this arrangement the two curves in the first three figures are nearly parallel, showing that in the middle regions of the United States the abnormal depressions of the barometer are attended with a rise in the thermometer and consequently an increase of moisture, while in the eastern States, as illustrated by figure 4, the result is almost entirely opposite—the increase of temperature is accompanied with a rise in the barometer.

If we suppose that a south wind, of 10,000 feet in height, with a temperature of 70°, occupies the Mississippi valley, and the upper current from the west flows across its surface, in ordinary circumstances this stratum of air would weigh a little more than nine inches of mercury. Now, if we further suppose a cold northwest wind, having its dew point or morning temperature down to 30°, to displace the warmer current, by crowding it to the east and occupying its place, as ten thousand feet of air at this low temperature weighs 1-12th more, or ¾ inch of mercury, this denser and colder column will cause a rise in the barometer to that extent. Now, if a decrease of temperature of 40° causes a rise of ¾ inch of mercury, a decrease of 5° would cause a rise of nearly 1-10th inch. This effect would be produced without taking into account the changes which might take place during storms in the upper strata of the atmosphere.

I have compared the fluctuations of the barometer at 7, A. M., and 9, P. M., with the changes in the temperature at these hours from the 7th to 16th November last, in the States of Maine, Vermont, New York, Michigan, Wisconsin, North Carolina, Kentucky, Missouri, East Florida, Alabama, Texas, and also at Washington. By making 5° of temper-

ature correspond with 1-10th inch of mercury in the barometer, I find some very interesting results are brought out. In all the States south and west of the Alleghany range, the parallelism between the changes in the barometer and the changes in temperature are much greater than I anticipated. See figures Nos. 1, 2 and 3.

Some remarkable exceptions, however, occur, in which a rise of temperature is accompanied with a rise of the barometer. These exceptions are found to the east of the Alleghanies and the mountains of New England, where the curves of temperature and pressure of the air entirely lose the regularity which they possess in the southern and western States. The changes of the barometer before storms in the northeastern States appear to be very peculiar, at least I am acquainted with nothing like them in Europe. When the mercury rises a little above 30 inches in Great Britain, the index of the barometer points to "set fair," and an eastern storm rarely comes on before the mercury begins to sink. When the mercury is above 30 inches in Maine, during winter or autumn, a storm is often at hand, and the barometer does not fall before the weather gets colder and drier. An examination of the weather, from the 7th to 16th November last, (see figure 4,) apparently shows that the indications of the barometer, as a weather prophet, must be interpreted by a contrary rule to that which is observed in the western States and in England. The probable cause of this will be afterwards adverted to. I shall now proceed to give you an account of a general storm, which will serve to illustrate the principles I have stated:

The weather on the 12th November, 1854, presented a curious picture of extremes over the United States. The northwest wind was advancing like an extended wall, from Iowa to Texas, and clearing the whole country of its moisture. By looking at the following table of temperature for that day, we shall see the progress which it had made at the time mentioned:

Iowa, Poultney	11°	7, A. M.
Wisconsin, Madison	19°	"
Missouri, St. Louis	26°	"
Mississippi, Oxford	34°	9, P. M.
Texas, New Wied	36°	"

On the morning of the 12th the first killing frost was felt in Louisiana, and over Michigan, the northern parts of Illinois, Indiana, and Ohio, the ground was covered for the first time with snow. In these States the northwest wind was flowing beneath the colder edges of the southwest stream from the Gulf, forcing it to ascend and precipitate part of its moisture in the form of snow. As the under current rose it was caught by the upper current, and, as in the case of thunder storms, it was swept off towards the east. This at least seemed to be the process at Indianapolis, where, on the 12th, four inches of dry snow fell, while the lower wind from the north and northwest was overlaid by a current bearing clouds from the southwest. On the morning of the 13th, at the same place, the wind set in from the west.

On looking at the meteorological chart for the morning of the 12th, we perceive at a glance that the temperature gradually rises from Iowa to Maine, from Missouri to Savannah, and from Texas to Florida. The

eastern seaboard States now experienced the southwest stream of moist and hot air—hotter and moister than it was in the west, because while this moveable current is gradually borne to the east its temperature is higher from having been blowing longer from a warmer quarter—on the same principle that an ordinary south wind in summer is warmer the second day it blows than on the first. The temperatures on the east coast are in very striking contrast to what they are on the west of the Mississippi.

Florida,	wind	SW.,	temperature	70°, rainy.
Savannah,	"	SE.,	"	64°, rainy.
North Carolina, Thornbury,	"	E.,	"	60°, rainy.
Washington,	"	W.,	"	48°, rainy.
New York,	"	WNE.,	"	53°, rainy.
Maine, Steuben,	"	SW.	"	54°, rainy.

The weather remained moist and warm on the 13th in the Atlantic States, but the cold air was rapidly advancing from the northwest. By the morning of the 14th it had swept the whole of the southwest current into the Atlantic and brought cold and clear weather. In Florida the temperature of 70° on the morning of the 12th was changed to the freezing by the 14th; frosts also occurred on the same day in Georgia, South Carolina, North Carolina, Virginia, Pennsylvania, and New York. It is worthy of observation that at the very time the northwest wind was making its cold felt from Florida to New York, the south wind, or a modification of it, had already set in over Texas, and raised the temperature 15°, and its influence was afterwards also felt as far north as St. Louis, in Missouri. This was merely the first stage of preparation for another atmospheric disturbance which was to run a similar course.

Striking changes in the temperature of the weather are produced in autumn by the colder wind from the west descending and bearing the moister stream before it; when this hot stream is extended along the Atlantic coast it in all probability becomes the vehicle of the hurricanes which proceed from the West Indian islands. A severe hurricane, having its course along the Florida coast, desolated the rice grounds on the Charles and Savannah rivers on the 8th September last; but a thunder storm, extending over the greater portion of the northern States, began on the 6th and travelled from northwest to southeast, causing a great atmospheric disturbance and lowering of the temperature.

We have only space to say a few words on the barometer during the storm of the 12th. Though rain and snow fell over an immense area that day, and the wind blew with great force in the Atlantic States, still the barometer was above the mean in the morning from Maine, in the east, to Wisconsin, in the west. In this section it is probable that the northwest current, overlying the whole storm, did not sweep away the ascending moist currents with sufficient rapidity, and hence the accumulation of air causing the barometer to rise before storms on the east coast. The Alleghany range must, so far, favor this accumulation by retarding or hindering the freer action of the winds from the west. When the air has a high temperature in summer, the increased pressure before storms is, I believe, not so much observed. In this storm, also,

I find no traces of accumulation of air in Florida, where the curves of pressure and moisture coincide very accurately, as much so as they do throughout the Mississippi valley. The following reductions exhibit the state of the barometer over three sections of the United States. The figures show the difference of the pressure above or below the mean for the month, in hundredths of an inch:

First Section.

Maine...........	at 7 A. M.	....	+ .23 inches.
Vermont.........	" "	....	+ .21 "
New York (State).	" "	....	+ .33 "
Michigan........	" "	....	+ .16 "
Wisconsin.......	" "	....	+ .21 "

Second Section.

North Carolina....	at 7 A. M.	....	0 mean.
Kentucky........	" "	....	—.17 inches.
Missouri.........	" "	....	+ .12 "

Third Section.

East Florida......	at 7 A. M.	....	—.18 inches.
Alabama..........	" "	....	—.17 "
Texas...........	" "	....	+ .41 "

During the weather from the 7th to the 16th of November, the fluctuations of the barometer in the southern and western States do not seem to have been greater than could be ascribed to the changes of temperature. The great fall of the barometer in tropical storms, and the tornadoes of the United States, seem to me to admit of no other explanation than that given by Professor Espy, viz: an inward ascending column of air becoming much lighter from the extrication of latent caloric.

In regard to the winds, during the progress of this storm, only two systems are well developed. The northwest winds, on the 10th, were observed both in the rear and front, while the southwest current occupied the middle. The east wind is so partially developed, that we must regard it merely as an eddy in the more general system which embraces it. We cannot expect to find much regularity in the course of any set of winds, because this can only take place with an invariable temperature. Inequality of local temperature is the principal cause of the irregularity of the arrows which represent the direction of the wind on the meteorological chart.

On the 12th, the weather was very wet and stormy along the Atlantic States, and much rain also fell in the Ohio valley. Snow fell over a considerable area immediately to the south of the lakes.

We shall now very briefly trace the peculiarities of the weather and storms of Europe. The east wind very seldom blows over a large area of the United States, unless during storms. In northern Europe the case is very different: dry and cold winds are very common in spring, and, at this season, not only is the surface wind from the east, but the current in the higher regions is also from the same quarter. It usually bears cirrous clouds, thus showing the great height to which it extends in the atmosphere. So long as the east wind blows as an

undivided current in winter, the weather is intensely cold in England. Coming over ranges of mountains and a long stretch of land, it is something like the west wind of the United States—as long as it is continuous, the cold is unabated; when the same wind prevails in summer the whole country is parched with drought; but when the surface east wind is overlaid by a current from the southwest, then the east wind becomes excessively wet and disagreeable. An east wind in Scotland is very rarely stormy either in summer or autumn, unless it has an upper current from the southwest. This upper current from the ocean supplies the moisture which is precipitated by the lower wind. After long periods of dry summer weather in Scotland, the barometer begins to fall several days before the rain storm comes on. The first symptoms of change are, usually, cirrous clouds floating in the upper regions of the atmosphere, and indicating a greater saturation going on above. Cumulous clouds at length form, and drift from southwest to northeast, often directly against the lower wind. A thunder storm begins the rainy season; and so long as the upper current continues, the east wind is rainy or moist.

The fall of the barometer, it would appear, arises from a warm and moist stratum of air taking the place of a colder one above; on the same principle as a moister and warmer one depresses the barometer in the Mississippi valley. For this reason the barometer is very much consulted as an indicator of changes in the weather in Great Britain.

The summer rain-storms often extend over a large area in Europe. I have traced the northeast wind blowing, as a broad current, from the Alps to the south of Scotland, while rain was falling over the greater part of this space.

The winter storms are also regulated by the same principles. When there is no upper current from the west, the east wind remains dry and cold; but when the southwest upper current begins to blow, it becomes wet and stormy, and almost all the great falls of snow in winter take place under these conditions. The barometer does not give as long a warning of an approaching storm in winter as it does in summer, but there is invariably a fall in the mercury before the storm comes on. To illustrate the character of our winter storms the following example is given:

During the month of December, 1853, the wind was, in general, east in England, not only at the surface of the ground but at great elevations in the atmosphere. The barometer was high and steady for that winter month. The rivers from the north to the south of the island were more ice-bound than they had been for 15 years.

On the 1st of January, 1854, the weather was very cold over Great Britain, as well as the northwest of Europe. There was no storm that day, and the temperature of the air did not differ much from Sandwich, in Orkney, to Brussels, in Belgium.

	Wind.	Temperature. Max.	Min.
Sandwich Manse, Orkney	NW	28°	28°
Keleoliess, Fife	NW	34°	12°
Highfield, Nottingham	WNW	32°	14°
Liverpool, Lancashire	NNW	36°	27°

Holkham, Norfolk	W.	38°	= 20°
Helsten, Cornwall	NW.	41°	34°
St. Aubin, Jersey	NW.	35°	32°
Versailles, France	NW., calm	32°	24°
Brussels, Belgium	SW., calm	29°	24°
Heligoland, Denmark	N., stormy	...	

A disturbing element was, however, after a short time introduced; at Jersey the wind set in from the westsouthwest on the morning of the 2d, and a thaw commenced; the wind was high from this quarter at night, with heavy rain. A current also set in from the southwest, both at Versailles and Brussels, with snow falling more or less during the whole day. At Helsten, near Land's End in Cornwall, the wind was northeast, and 7-10th inch rain fell in the night; but it is quite evident that this rain, thrown down by the northeast wind, must have been derived from the upper current from the southwest, as the air still remained dry and frosty at Bath, on the west, and at Holkham, on the east. This supposition is rendered highly probable, from the fact that the upper stratum of clouds was from the southwest. It was some time before the storm was developed in the eastern counties.

The wind seems to have begun to blow very briskly from an easterly quarter over the south of England on the 3d, with much snow at night. An inch of rain fell that day in Jersey, with a squally wind from the east. The temperature remained low and the sky clear in Scotland and the north of England. The wind was from an easterly quarter that day at Paris, Brussels, and off the coast of Denmark. The southwest upper current, still prevailing, saturated the air all over England and the south of Scotland, and a violent storm of snow on the 4th was the result, which extended over a large portion of the west of Europe, the wind being easterly at almost all the different stations. It is curious to observe that no snow or rain fell at Helsten, near Land's End, on the 4th, the point to which all the wind on the east coast was blown; which shows that it must have been absorbed in some way before reaching the west coast. In Scotland the wind, on the 4th of January, was quite as violent as in the south of England; but very little snow fell on the eastern coast. A deep snow fell, with a strong northeast wind, at the temperature of 32°. The wind was excessively cold and dry in Aberdeen, being as low as + 9° max. — 6° min. The upper current had not influenced it sufficiently to raise the thermometer above these low temperatures. During this very low temperature in Aberdeenshire, the northeast wind was about 23° higher in Belfast. This difference of temperature is vastly greater than in the case of a sea breeze, and might alone account for the violent gale on the Irish coast.

The disturbance of the equilibrium of the atmosphere in this and our other winter storms seems to be occasioned, first, by a flowing away of part of the cold upper current, and a warmer and lighter air taking its place; and, second, by the denser air below flowing towards the warm and moist air over the ocean, which causes the saturated air to rise to a greater elevation, and condense its moisture. The condensed vapor, by the extrication of its caloric, favors ascending currents, which are gradually absorbed into the upper current and carried towards the earth. I have already mentioned that no snow or rain fell at Land's End

while the day was nearly calm, and at the same time a violent hurricane, with much snow, was apparently blowing right towards this very locality. But this case exactly resembles the action of the sea breeze—the northeast wind being gradually absorbed into the upper current along the whole area over which it blows. The warming influence of the southwest upper current is well illustrated by the fact, stated to me by Mr. Moyle, that snow did not cover the ground for an hour last winter, though much fell with the northeast wind not far to the eastward of his place.

Though the storm had begun at Heligoland on the afternoon of the 5th, it did not reach Aberdeenshire on the 4th. The northeast winds were quite dry beyond this county; and the sky at Sandwich, in Orkney, was bright, and the air quite calm. Notwithstanding the prevalence of the easterly winds, we find that the temperature is advanced from west to east, especially along the western coast of Europe; and on the 6th, the upper current seems to have so completely worn away the lower current, that the wind was from the southwest on that day from Cornwall to Belgium. But in the north of England and over Scotland the lower current increased in depth, and for a time checked the warm upper current, or drove it back, and restored cold weather. All places under the influence of the southwest wind had their temperature raised, while those under the northeast had it depressed. This will be shown by the following table of temperature and direction of the wind:

Helsten,	S. W.	minimum	36°	Orkney	E.	minimum	23½°
Jersey,	S. S. W.	"	38°	Aberdeen	calm	"	10°
Paris,	S. W.	"	35°	Fifeshire	E.	"	30°
Brussels,	S. W.	"	34°	Liverpool	S. E.	"	30°

This may be taken as an example of our eastern storms. They are preceded by a fall of the barometer, but the manner in which they terminate has nothing of that regularity which distinguishes your storms. Very often the southwest wind blows as a deep current, and produces moist and warm weather in the depth of winter. The lower eastern wind, which is often very stormy, must be regarded as a mere surface stream, which is usually absorbed by the deeper upper current.

Now, I think it is very probable that an action similar to that of our northeastern storms is sometimes developed over the United States and in Canada. While I was sailing down the St. Lawrence, in the beginning of last October, a strong head wind prevailed from the northeast, at the same time that the clouds at no great height were drifting from the southwest. At Quebec, I also observed the same phenomenon; and, according to Professor Mitchell, of North Carolina, northeast storms are sometimes developed over large portions of the United States when the clouds are from the opposite quarter. I have had no opportunities since I have been in this country to examine the northeast rain storms, which appear to be more frequent in the New England States than to the south. But I suspect we must always bear in mind that an upper current flows from the west quarter even when the lower northeast wind and middle southwest current are prevailing.

There is another class of storms of very common occurrence in Great

Britain, during the continuance of which there are very rarely any east winds. There is also this peculiarity about them, that they seldom give warning of their approach by any fall in the barometer; indeed, it often shows a pressure above the mean just before they commence. The wind springs up from the southwest, and blows as a broad stream over the whole island, and in almost all these storms an upper current prevails from the northwest, which descends before the termination of the disturbance, and at once brings cold and dry weather. This particular form of atmospheric disturbance occurs at all seasons of the year, sometimes as a very gentle breeze, and often as storms of the most violent character. The changes of the wind are from southwest to northwest, crossing due west at once, and at this time blowing with their greatest violence. But our limits forbid us to enter further into this subject.

In the course of these lectures it has been my wish to state as clearly and distinctly as possible the general principles on which nearly all meteorologists are agreed, and to avoid, as far as might be, the discussions of points in reference to which there is less harmony of opinion. I have been anxious to place before you what I consider to be the distinctive features of the storms of North America and of Europe. I am quite aware that the topic would have furnished materials for a much greater number of lectures, but a mere outline was all that could be properly attempted in the time allotted. I have presented the phenomena in the connexion in which they now represent themselves to my mind. I may, however, have reason to modify my present views of American storms when I have found leisure to arrange and discuss more thoroughly the ample materials I have collected in my tour. But, whatever may be the change in this respect, I shall always retain a lively and constant impression of the kindness, the hospitality, and the liberality which I have everywhere met with in my travels through this favored land.

APPENDIX TO MR. RUSSELL'S LECTURES, BY THE SECRETARY OF THE SMITHSONIAN INSTITUTION.

As an appendix to Mr. Russell's lectures, we give the following tables, showing the mean diurnal variations of the temperature, moisture, pressure, &c., of the air. The principal series are from observations made at Greenwich, near London, under the direction of Mr. Glaishier. The tables for Bombay are from the observations of Dr. Buist, those for Philadelphia are from the valuable series made under the direction of Professor Bache at Girard College.

By a comparison of the quantities given, it will be seen that all the changes are connected with and depend upon the position of the sun in the heavens, or, in other words, upon the amount of solar heat received at the different hours of the day. The numbers given in the series for Greenwich are deduced from the observations continued for several years, comprising more than 20,000 individual records, and, therefore, abnormal variations are eliminated, and the special changes due to constant causes are exhibited in their true values.

Table I gives the mean diurnal variation of the temperature of the air in the shade at intervals of two hours, from 2 o'clock in the morning until the end of the 24 hours. It will be seen by this table that on the average the coldest period of the day is a little before sunrise, and that the temperature of the air remains nearly stationary from about 4 o'clock until near 6 o'clock in the morning, that it then gradually rises until 2 p. m., when it reaches its maximum, and then declines. The first rays of the sun are probably expended in vaporizing the dew and moisture at the surface of the earth, and as this process renders a large portion of heat latent the air does not increase very rapidly in temperature.

TABLE I.

MEAN DIURNAL VARIATION OF TEMPERATURE AT GREENWICH.

2 A. M.	4 A. M.	6 A. M.	8 A. M.	10 A. M.	NOON.	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.	12 NIGHT.
45° 4′	44° 8′	44° 8′	46° 9′	50° 4′	53° 6′	55° 1′	54° 5′	52° 3′	49° 5′	47° 5′	46° 3′

— Minimum. + Maximum.

TABLE II.

MEAN DIURNAL VARIATION OF THE WEIGHT OF WATER IN A CUBIC FOOT OF AIR AT GREENWICH.

2 A. M.	4 A. M.	6 A. M.	8 A. M.	10 A. M.	NOON.	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.	12 NIGHT.
GR. 3.52	GR. 3.49	GR. 3.51	GR. 3.64	GR. 3.78	GR. 3.88	GR. 3.92	GR. 3.89	GR. 3.79	GR. 3.71	GR. 3.63	GR. 3.58

— Minimum. + Maximum.

Table No. II gives the mean diurnal variation of the absolute weight in grains of moisture in a cubic foot of the air, as determined by a

series of calculations from the record of the observations of the wet and dry bulb thermometer.

It will be seen by a comparison of table No. II with table No. I that as the temperature increases, the amount of water which exists in the air as vapor also increases. The two elements heat and moisture mutually influence each other as to the quantity present in the atmosphere at a given time. With an increase of elevation of the sun above the horizon its rays pass to the earth through the atmosphere less obliquely and impinge more perpendicularly on the surface. This produces an increased amount of vapor, with an increased elastic force, which enables the air in turn to absorb and retain a larger quantity of heat.

The maximum quantity of moisture is at 2 p. m. The increase in weight is from about 3½ grains to near 4 grains.

This table, however, does not give the amount of vapor which the air could hold if sufficient moisture were present to entirely saturate it. Indeed the air is very seldom fully saturated, and in order to begin to precipitate the vapor it contains into water, it is generally necessary to lower the temperature quite a number of degrees. The point of temperature at which the moisture begins to settle—for example, on the surface of a bright tin cup partly filled with water which is slowly cooled down by gradually adding ice water—is called the *dew point*. The greater number of degrees the water is obliged to be lowered before dew begins to be deposited, or the greater the difference between the temperature of the air and the dew point the greater is the dryness of the air, or the greater is the tendency of vapor to exhale from the skin and from all bodies containing moisture.

Table No. III gives the mean diurnal variation in the dew point.

TABLE III.

MEAN DIURNAL VARIATION OF THE DEW POINT AT GREENWICH.

2 A. M.	4 A. M.	6 A. M.	8 A. M.	10 A. M.	NOON.	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.	12 NIGHT.
43° 1′	42° 9′	42° 9′	44° 0′	45° 2′	46° 2′	46° 5′	46° 3′	45° 6′	44° 7′	44° 1′	43° 6′

— Minimum. + Maximum.

If we subtract the numbers in this table from those in Table No. 1, we shall have approximately the relative dryness, or evaporating power of the air; this is given in No. IV.

TABLE IV.

MEAN DIURNAL VARIATION OF DRYNESS, (APPROXIMATELY,) AT GREENWICH.

2 A. M.	4 A. M.	6 A. M.	8 A. M.	10 A. M.	NOON.	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.	12 NIGHT.
2° 3′	1° 9′	1° 9′	2° 9′	5° 2′	7° 4′	8° 6′	8° 2′	6° 7′	4° 8′	3° 4	2° 7′

— Minimum. + Maximum.

From this it appears that the minimum dryness or greatest dampness of the air also occurs at four o'clock in the morning, and the maximum dryness at two o'clock in the afternoon.

The degree of humidity, however, of the air, may be more definitely expressed by the result of a more laborious process, namely, by dividing the weight of water in the air at a given time by the whole quantity the air could hold if it were saturated. By making the necessary calculation, and considering the point of saturation as unity, we shall have the following table:

TABLE V.

MEAN DIURNAL VARIATION OF THE HUMIDITY OF THE AIR AT GREENWICH

2 A. M.	4 A. M.	6 A. M.	8 A. M.	10 A. M.	NOON	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.	12 NIGHT.
0.926	0.934	0.938	0.906	0.843	0.783	0.753	0.761	0.800	0.851	0.891	0.914

\+ Maximum. — Minimum.

When the quantity of water is in the least degree greater than the atmosphere can contain at a given temperature, condensation takes place, which may be either in the form of fogs or dew in the lower strata or clouds, and rain in the upper. The formation of clouds will therefore depend on the amount of moisture in the atmosphere. This is shown by

TABLE VI.

MEAN DIURNAL VARIATION OF THE CLOUDINESS OF THE ATMOSPHERE AT GREENWICH.

2 A. M.	4 A. M.	6 A. M.	8 A. M.	10 A. M.	NOON.	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.	12 NIGHT.
.65	.67	.69	.70	.71	.71	.71	.69	.66	.62	.60	.61

\+ Maximum. — Minimum.

The actual weight of a given portion of the air is also affected by the variation of temperature. This is shown in the following table, in which the minimum of weight occurs at the hour of maximum temperature.

TABLE VII.

MEAN DIURNAL VARIATION OF THE WEIGHT OF A CUBIC FOOT OF AIR AT GREENWICH.

2 A. M.	4 A. M.	6 A. M.	8 A. M.	10 A. M.	NOON.	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.	12 NIGHT.
Gr. 541.7	Gr. 542.2	Gr. 542.2	Gr. 540.1	Gr. 536.3	Gr. 532.9	Gr. 531.0	Gr. 531.5	Gr. 533.9	Gr. 537.2	Gr. 539.4	Gr. 540.6

\+ Maximum. — Minimum.

sure upon a square foot in pounds avoirdupois at each hour of the 24. The numbers are those given by Osler's self-registering anemometer.

TABLE IX.

MEAN DIURNAL VARIATION OF THE PRESSURE OF THE WIND AT GREENWICH.

1 A. M.	2 A. M.	3 A. M.	4 A. M.	5 A. M.	6 A. M.	7 A. M.	8 A. M.	9 A. M.	10 A. M.	11 A. M.	NOON.
603¼	584¼	546	558½	575	585¾	650¾	781	906¾	1.008¾	1.204½	1.360

Minimum. (3 A. M.)

1 P. M.	2 P. M.	3 P. M.	4 P. M.	5 P. M.	6 P. M.	7 P. M.	8 P. M.	9 P. M.	10 P. M.	11 P. M.	12 NIGHT.
1.405¼	1.415¾	1.323¼	1.187	1.032½	874	721	649¼	649¾	634	650½	642¼

Maximum. (2 P. M.)

For the purpose of comparison, and to illustrate the fact that the diurnal variations of the meteorological elements follow the same general law in the parts of the earth the most widely separated, the following tables are given from observations made at Bombay:

TABLE X.

MEAN DIURNAL VARIATION OF TEMPERATURE AT BOMBAY, 1843.

2 A. M.	4 A. M.	6 A. M.	8 A. M.	10 A. M.	NOON.	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.	12 NIGHT.
79° 4′	78° 9′	78° 4′	79° 6′	81° 8′	83° 2′	84° 1′	83° 9′	82° 3′	81° 2′	80° 3′	79° 8′

Minimum. (6 A. M.) Maximum. (2 P. M.)

The minimum temperature in this table occurs at 6 a. m., and the maximum at 2 p. m.

TABLE XI.

MEAN DIURNAL VARIATION OF TENSION OF VAPOR AT BOMBAY, 1843.

2 A. M.	4 A. M.	6 A. M.	8 A. M.	10 A. M.	NOON.	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.	12 NIGHT.
0.766	0.761	0.750	0.766	0.771	0.778	0.795	0.800	0.802	0.801	0.780	0.775

Minimum. (6 A. M.) Maximum. (6 P. M.)

According to this table the tension or elastic force of vapor at Bombay arrives at its minimum at 6 a. m., and its maximum not until 6 p. m. This difference in the time of the maximum and minumum at Bombay and Greenwich probably arises from the tropical position of the former.

TABLE XII.

MEAN DIURNAL VARIATION OF THE BAROMETER AT BOMBAY, 1843.

2 A. M.	4 A. M.	6 A. M.	8 A. M.	10 A. M.	NOON.	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.	12 NIGHT.
In. 29.786	In. 29.778	In. 29.805	In. 29.840	In. 29.852	In. 29.817	In. 29.776	In. 29.755	In. 29.774	In. 29.806	In. 29.825	In. 29.809
	− Minimum.			+ Maximum.			− Minimum.			+ Maximum.	

This table exhibits, as in the case of that for Greenwich, two maxima and two minima.

The following tables exhibit the mean diurnal variations in the meteorological elements at Girard College, Philadelphia. They present the result of the observations for each hour of the 24.

TABLE XIII.

MEAN DIURNAL VARIATION OF THE TEMPERATURE OF THE AIR AT PHILADELPHIA.

Computed from the observations made in 1842, *and from the* 1*st July*, 1843, *to the* 1*st July*, 1845.

1 A. M.	2 A. M.	3 A. M.	4 A. M.	5 A. M.	6 A. M.	7 A. M.	8 A. M.	9 A. M.	10 A. M.	11 A. M.	NOON.
48.2	47.8	47.3	46.8	46.6	47.0	48.1	50.1	52.1	54.1	55.7	56.8
				− Minimum.							

1 P. M.	2 P. M.	3 P. M.	4 P. M.	5 P. M.	6 P. M.	7 P. M.	8 P. M.	9 P. M.	10 P. M.	11 P. M.	12 NIGHT.
57.9	58.6	58.9	58.7	57.7	56.0	54.1	52.5	51.0	50.2	49.4	48.7
		+ Maximum.									

By comparing table XIII with table I, it appears that the diurnal variation of temperature, at Greenwich and Philadelphia, is nearly the same. The minimum occurs a little earlier at the latter, and the maximum a little later.

TABLE XIV.

MEAN DIURNAL VARIATION OF THE DEW-POINT AT PHILADELPHIA.

Computed from the observations made from the 1st July, 1843, to 1st July, 1845.

1 A. M.	2 A. M.	3 A. M.	4 A. M.	5 A. M.	6 A. M.	7 A. M.	8 A. M.	9 A. M.	10 A. M.	11 A. M.	NOON.
42.0	41.7	41.4	41.1	41.1	41.4	42.0	42.9	43.7	44.1	44.3	44.5

— Minimum.

1 P. M.	2 P. M.	3 P. M.	4 P. M.	5 P. M.	6 P. M.	7 P. M.	8 P. M.	9 P. M.	10 P. M.	11 P. M.	12 NIGHT.
44.7	44.6	44.5	44.1	43.7	43.7	43.6	43.3	43.1	42.9	42.7	42.3

+ Maximum.

The variations of the figures, in table XIV and table III, also follow the same general law.

TABLE XV.

MEAN DIURNAL VARIATION OF DRYNESS, (APPROXIMATELY,) AT PHILADELPHIA.

Computed from the observations made from July 1, 1843, to July 1, 1845.

1 A. M.	2 A. M.	3 A. M.	4 A. M.	5 A. M.	6 A. M.	7 A. M.	8 A. M.	9 A. M.	10 A. M.	11 A. M.	NOON.
6.1	6.2	5.7	5.6	5.3	5.4	6.0	6.9	8.2	10.0	11.3	12.3

— Minimum.

1 P. M.	2 P. M.	3 P. M.	4 P. M.	5 P. M.	6 P. M.	7 P. M.	8 P. M.	9 P. M.	10 P. M.	11 P. M.	12 NIGHT.
13.3	14.1	14.5	14.8	14.2	12.6	10.7	9.4	8.3	7.4	6.8	6.4

+ Maximum.

From table XV, it does not appear that Mr. Russell's rule, for ascertaining the dew point from the minimum temperature, holds true in Philadelphia. Table No. IV, gives a much nearer approximation, and, in moist seasons, the same will probably be the case in this country, particularly at the south. By comparing the quantities given in table No. XV, with those in table No. IV, it will be seen that the relative dryness of Philadelphia is much greater than that of London or Greenwich.

TABLE XVI.

MEAN DIURNAL VARIATION OF THE CALCULATED FORCE OF VAPOR AT PHILADELPHIA.

Computed from the observations made in 1842, *and from July* 1, 1843, *to July* 1, 1845.

1 A. M.	2 A. M.	3 A. M.	4 A. M.	5 A. M.	6 A. M.	7 A. M.	8 A. M.	9 A. M.	10 A. M.	11 A. M.	NOON.
.344	.341	.334	.335	.333	.336	.343	.351	.359	.363	.365	.369

—
Minimum.

1 P. M.	2 P. M.	3 P. M.	4 P. M.	5 P. M.	6 P. M.	7 P. M.	8 P. M.	9 P. M.	10 P. M.	11 P. M.	12 NIGHT.
.371	.375	.375	.373	.376	.376	.372	.364	.358	.353	.350	.348

+
Maximum.

TABLE XVII.

MEAN DIURNAL VARIATION OF ATMOSPHERIC PRESSURE, BAROMETER REDUCED, AT PHILADA.

Computed from the observations made in 1842, *and from July* 1, 1843, *to July* 1, 1845.

1 A. M.	2. A. M.	3 A. M.	4 A. M.	5 A. M.	6 A. M.	7 A. M.	8 A. M.	9 A. M.	10 A. M.	11 A. M.	NOON.
29.938	29.936	29.933	29.935	29.941	29.951	29.960	29.966	29.969	29.967	29.958	29.944

— Minimum. + Maximum.

1 P. M.	2 P. M.	3 P. M.	4 P. M.	5 P. M.	6 P. M.	7 P. M.	8 P. M.	9 P. M.	10 A. M.	11 A. M.	12 NIGHT.
29.927	29.916	29.910	29.909	29.911	29.918	29.927	29.935	29.943	29.946	29.949	29.941

— Minimum. + Maximum.

Table XVII shows two maxima and two minima in the height of the barometer, which correspond very nearly in time with those of table VIII for Greenwich.

TABLE XVIII.

MEAN DIURNAL VARIATION OF THE FORCE OF WIND, IN POUNDS, AT PHILADELPHIA.

Computed from the observations made in 1843 and 1844.

1 A. M.	2 A. M.	3 A. M.	4 A. M.	5 A. M.	6 A. M.	7 A. M.	8 A. M.	9 A. M.	10 A. M.	11 A. M.	NOON.
.50	.50	.52	.53	.51	.47	.47	.56	.64	.80	.88	.98
			+ Maximum.		— Minimum.						

1 P. M.	2 P. M.	3 P. M.	4 P. M.	5 P. M.	6 P. M.	7 P. M.	8 P. M.	9 P. M.	10 P. M.	11 P. M.	12 NIGHT.
1.02	1.03	1.03	.98	.82	.61	.59	.50	.51	.52	.50	.47
	+ Maximum.										— Minimum.

Table XVIII, compared with table IX, exhibits a greater mean pressure of the wind at Greenwich than at Philadelphia. The maximum intensity, during the whole 24 hours is, in both tables, at 2 P. M.

TABLE XIX.

MEAN DIURNAL VARIATION OF THE SKY COVERED BY CLOUDS, AT PHILADELPHIA.

Computed from the observations made from the 1st July, 1843, to 1st July, 1845.

1 A. M.	2 A. M	3 A. M.	4 A. M.	5 A. M.	6 A. M.	7 A. M.	8 A. M.	9 A. M.	10 A. M.	11 A. M.	NOON.
.60	.61	.61	.65	.70	.74	.79	.86	.83	.85	.86	.88
— Minimum.											

1 P. M.	2 P. M.	3 P. M.	4 P. M.	5 P. M.	6 P. M.	7 P. M.	8 P. M.	9 P. M.	10 P. M.	11 P. M.	12 NIGHT.
.88	.89	.87	.88	.83	.80	.74	.69	65	.64	.65	.63
	+ Maximum.										

Tables XIX and VI exhibit nearly the same variation in the time of greatest and least cloudiness at Greenwich and Philadelphia.

EXTRACTS

FROM THE

SCIENTIFIC CORRESPONDENCE

OF THE

SMITHSONIAN INSTITUTION.

On Mr. John Wise's observations and inferences respecting the phenomena of a thunder storm, to which he was exposed during an aerial voyage, made by means of a balloon, June 3, 1852, *from Portsmouth, Ohio.*

BY DR. ROBERT HARE.

1. I have read with great interest the account published by Mr. Wise, a well known æronaut, of his balloon ascension during a thunder storm. This heroic excursion should awaken much attention in the scientific world, as opening a new and fruitful avenue to meteorological research in the immediate theatre of the stormy commotions of the atmosphere. The query "*Cui bono?*" can no longer be reasonably put to those who, like Wise, have been thought *unwisely* to have subjected themselves to risk in the sterile field of æronautic adventure.

2. The fact that this ærial voyage is the one hundred and thirty-first of those of which this veteran æronaut has survived the perils, indicates that they have not been so perilous in reality as in appearance; nor, so far as can be judged from the facts furnished by Wise's letter, does the unusual circumstance of a cotemporaneous thunder storm appear to add to the danger. Moreover, this practically safe result is just such as an attentive consultation of the well ascertained laws of electricity would justify. It is quite consistent with those laws that the æronaut, seated in his car, suspended by silken cords from a silken globe, should be more secure than persons simultaneously situated on terra firma beneath the clouds by which the balloon is surrounded. Supported as described, in the non-conducting air, by a non-conducting apparatus, an animal must be too well insulated to become the means of an electrical discharge, whether from the clouds to the earth, or

from one cloud to another. Neither the diameter nor length of the human frame would be sufficiently great, in proportion to the interval to be percurred, to cause a discharge of lightning to deviate much from any route which it otherwise would pursue, in order to employ that frame as a part of its circuit in the discharge.

3. There would be more risk of suffering by a dynamic inductive shock. This shock is exemplified when persons are stunned while near one who is directly struck. Yet while enveloped in a thunder cloud, the æronaut could not be injured by any discharge, whether between that cloud and another or between it and the earth.

4. The most intense electrical excitement, as imparted by a powerful machine to an animal supported by an insulated stool, produces no serious discomfort, so long as no spark is taken from any particular spot. The destructive violence of electricity is only displayed during transition, as when a comparatively slender body is made the medium of reciprocal neutralization to oppositely excited surfaces.

5. Under this view of the case, it is to be hoped that Mr. Wise may prove the pioneer in a new career of observation, and that encouraged and instructed by his example, a succession of scientific observers may visit the region of clouds during thunder gusts and gales.

6. The greatest source of danger is the violence of the winds, which when high must make it difficult to quit the terrestrial surface, or to descend upon it with safety. The velocity of the wind, *however great*, would have no more influence upon a balloon floating in it aloft, than the orbitual movement of our planet upon the bodies resting upon its surface.

7. As, agreeably to the narrative of Mr. Wise, the ascension commenced at half-past five, p. m., it is inconceivable how a landing could have been effected at nearly one hundred miles from the place of starting, especially as in the fifth paragraph of his synopsis he alleges that he was in the margin of the third storm noticed, twenty-five minutes. It is to be presumed that there is an erratum as respects the time, either of the commencement or of the termination of his voyage.

8. Presuming, however, that the observations of Mr. Wise are reliable as respects certain phenomena which bear upon the theory of storms, I will endeavor to show that they are quite consistent with the idea that electricity is a principal agent in the generation of storms.

9. Mr. Wise gives the following synopsis of the observations made during his aerial voyage:

"1st. Thunder storms have two plates of clouds; the upper of these discharging the contents, whatever they may be, whether rain, hail, or snow.

"2d. Sheet lightning, of an orange color, undulates silently between the upper and lower strata of clouds, with a waving motion.

"3d. Discharges of electricity take place from the lower cloud. By discharges are meant thunder and lightning.

"4th. The distance between the upper and lower cloud was not less than two thousand feet, by eye measurement.

"5th. The current uprising from the terrestrial surface was not continued higher than the lower cloud, and was rising and whirling, while I was in the margin of the storm, during twenty-five minutes.

"6th. The storm was much wider below than above and diverging at least twenty-five degrees from a perpendicular line.

"7th. The deposition of rain and hail was thicker about the centre of the storm.

"8th. Under the shadow of the upper cloud it is very cold, and in the lower cloud quite warm. The upper cloud was moved by the current which always moves from west to east."

To these allegations Mr. Wise might have added the following, as they are merely a repetition of facts alleged in his narration:

9th. A balloon, instead of being borne ahead by the current of air in which it floats, may be so approximated as to be involved in the "outskirts of its rain," and be made to "rack by its whirling motion."

10th. A third cloud may be formed by the rushing together of two others, seen previously in opposite quarters, and remote from each other.*

11th. The gas in a balloon may be so acted upon by the electric medium around it, as to acquire an augmentation of volume equivalent to calorific expansion.

10. The existence of two "plates," or strata, of clouds, as stated in paragraph 1st of the above synopsis, I have for some time considered as the usual concomitant of rainy weather. When, agreeably to the observations of Dalton, on which Espy founded his theory of storms, the vapor in an ascending mass of air is condensed, by the rarifaction and consequent increase of calorific capacity, which the air acquires on attaining the elevated region usually occupied by the clouds, this increase of capacity enables it to rob the aqueous vapor associated with it of heat; but by these means becoming warmer than if this vapor were not present, it consequently acquires an ascensional power; but by admixture with a larger portion of air, the warmth and moisture are again absorbed in the state of vapor, so that the clouds thus created below a certain level are reabsorbed at a higher level, producing a cold proportionally as great as the heat resulting from its condensation. This may be called the level of absorption, while the level at which they are created may be called the level of condensation. Between these levels the clouds, in fine weather, seem to float as if they were persistent, when, in reality, they are no more of this character than the fog which surmounts the escape-pipe of a steam-boiler when letting off steam.

11. Yet the moisture which escapes from permanent condensation at the first level at which this process takes place, by reaching a higher level, may be a second time condensed, by which a second stratum of clouds, as much colder as the associated air is rarer, may be generated. The process of reabsorption which had previously taken place immediately above the lower stratum, can now only take place immediately above the upper stratum, and, in consequence of the greater refrigera-

* Evidently the clouds which rushed together would have displayed this propensity had they been similarly electrified. In that case, they would have been reciprocally repulsive. But if oppositely charged, neutralization must have ensued, to a greater or less extent, according to their respective surfaces and intensities of excitement. This would have been inconsistent, more or less, with the formation of a thunder cloud. The only consistent explanation seems to be, that they were both attracted by the "*cloud cap*," which, according to Wise, is the source of the electricity discharged from the lower stratum in thunder gusts.

tion, must proceed with proportionally less rapidity. Consequently the absorption now no longer compensates for the condensation, and the excess must be precipitated as rain, hail, or snow.

12. That the upper stratum should be colder than the lower one, as alleged in the synopsis, is explained: first, by the difference of the altitude; secondly, the evaporation going on from the upper one must rob it of heat by a process from which the other stratum is protected by its presence; thirdly, radiation by the same superiority of altitude goes on copiously from the upper stratum, while this, by its interposition, checks radiation from the lower stratum.

13. The formation of clouds within the space occupied by the upper stratum must prove the air associated with those clouds to be saturated with moisture. Hence the clouds formed in any subjacent stratum cannot be absorbed within the interval between the strata, and must, of course, be more likely to accumulate so as to produce rain.

14. That the upper stratum should be so overcharged with electricity as to give it out in "sheet lightning," undulations, or aurora boreal corruscations, is perfectly consistent with the suggestion which I have advanced respecting the existence of three concentric spaces occupied severally by our globe—the denser non-conducting part of the atmosphere, and the rarified medium beyond that last mentioned, which is sufficiently rare to form a conductor or coating, the terrestrial surface performing a similar part within, the atmospheric electric existing intermediately.

15. The frequency of the aurora boreal corruscations and flashes is no doubt the consequence of discharges from one part of the exterior concentric space to another, especially when proceeding from either the arctic and antarctic regions to those of intermediate latitudes.

16. It is well known that ice, when very cold and, consequently, dry, performs the part of an electric no less than glass. The friction of globules, as existing in the fog produced by escaping steam, has been inferred by Faraday to be a competent source for the torrents of electricity generated by a high steam; and it is not improbable that the friction between wind and the terrestrial surface may induce opposite states in the stratum of air bounded by that surface and the stratum occupied by the earth, and that occupying the space above the region of the clouds.

17. The discharges of lightning are the means of equalization between these spaces. Observation shows that the higher regions of the atmosphere are equally surcharged with electricity so as to prove dangerous to travellers among the Sierras or table lands of the Andes. Hence the upper stratum of clouds is liable to be surcharged with electricity oppositely to the earth. But whatever electrifies the inner terrestrial coating must produce a proportional opposite excitement in the outer one.

18. When an upper stratum of clouds, such as Mr. Wise describes as the "cloud cup," is highly electrified by corruscations from the outer concentric space, as above supposed, it is consistent that it should attract the oppositely electrified air in the vicinity of the terrestrial surface. This air must at the same time undergo dilatation like that to which the gas in Wise's balloon was subjected, and must, of course, be repelled by the similarly electrified earth. Calorific expansion ma-

co operate, and thus an ascensional power be generated sufficient to make it rise to the region of the clouds, where rarefaction so increases the calorific capacity of the air, that it robs the aqueous vapor, existing in the air, of its heat, and thus condenses it into a cloud. Meanwhile the heat involved by the vapor in condensing keeps the temperature higher than if the moisture were not present, and, according to Espy, should be productive of an upward force competent to produce a tornado. But according to Wise's statements, the uprising current does not reach the upper stratum of clouds.

19. In the fifth paragraph of his synopsis it is alleged not to be continued higher than the lower cloud; but in his narrative he alleges that when "the balloon was half way down between the cloud and the lower stratum, the uprising current arrested the descent." and was rising and whirling as he was in the margin of the storm.

20. The fact that the balloon, instead of being carried ahead by the current in which the "thunder gust," first noticed by our voyager, floated, was carried towards it so as to be "involved in the outskirts of its rain," and to be affected by its motion, can only be ascribed to centripetal currents; and the whirl might be the natural consequence of the conflicting concurrence of such currents. The rising of the air in the axis of the whirl would require that there should be inblowing currents to supply the deficit created by this upward blast. It is difficult to comprehend why the balloon was not drawn into the vortex and carried round with it.

21. I have never seen nor heard any evidence justifying the idea that an ordinary thunder gust involves the existence of a whirling motion about a vertical axis. The rushing together of two thunder gusts, or clouds, to form a third, as stated in the narrative, and noticed in the 9th paragraph of the synopsis, indicates the existence of two currents rushing towards an intermediate space, where a whirl might contingently ensue, a result which is quite consistent with the inblowing theory, agreeably to which whirling is an incidental consequence, not a cause nor an essential feature of storms. In these respects Wise's observations are irreconcilable with the Redfield theory, which assumes the whole of the theatre of stormy reaction to whirl about a common axis. Agreeably to this idea, the two thunder gusts, instead of rushing towards each other, would have to be carried further apart by a centrifugal motion, and the air, instead of rising about the axis, would have been drawn downward to supply the centrifugal currents.

22. The persistence of the upper stratum, or "cloud cup," as this stratum is designated in the narrative, is inconsistent with the Espyan hypothesis, which requires that in every thunder gust, no less than in a tornado, that the whole mass of air, of which the commotions constitute the storm, should be turned inside out, by an upward blast produced by the heat arising from condensing vapor. Of course, this force could not come into existence below the level at which the condensation commences, in other words, that of the lower stratum of clouds, and could not continue to operate further than the inferior level of the upper stratum. Any buoyancy thus created would tend to carry up the "cloud cup," while it could have no effect at any level below

that at which the increase of temperature should commence, as I have proved, both experimentally and theoretically.

23. Supposing the electrical charge in the upper stratum to be the main agent in the phenomena, it would be consistent that its influence should be exercised more widely, as the air acted upon should be further off, since distance enlarges the sphere as it lessens the force of the attraction.

24. This seems to explain the widening of the stormy mass affected towards its base, as stated in the sixth paragraph of the synopsis.

25. Agreeably to the seventh allegation of the synopsis, the greatest deposition of rain took place towards the interior or central part of the stormy mass, while, according to Espy, the moisture ascends over the focal area, and descends on one or more sides. But Mr. Wise was not well situated to form an accurate estimate in this respect. Until the facts are better examined or confirmed, it were better to postpone the examination of this question.

26. The ninth paragraph is added by me, being founded on the allegations of Mr. Wise in the fourth, fifth, and sixth paragraphs of his narrative.

27. It must be evident that by the narrator the words thunder storm, or thunder gust, are used as synonymous with a stratum of thunder clouds; so that when he informs us that two tremendous thunder storms were approaching each other rapidly beneath him, it is evidently intended to convey the idea of two great thunder clouds coming together so as to form one.

28. This is not the first time that the coming together of two thunder clouds has been alleged to happen. In the report on the tornado of Chenay, by Peltier, such an approximation is stated to have preceded the formation of the meteor. Evidently they could not be brought together by charges of electricity unless those charges were of an opposite kind; but if they were of an opposite kind, the union of the clouds would have caused reciprocal neutralization, so far as their charges were equivalent. This result would have been inconsistent with that augmentation of electrical energy consequent to their uniting, which is in both cases alleged to have ensued. The only explanation which I can suggest, consistently with the laws of electrical reaction, is, that these masses of vapor were both neutral, and that they were both attracted simultaneously by the upper stratum of clouds, designated by Mr. Wise as the "cloud cup," and charged therefrom as soon as they attained sufficient proximity so as to form one cloud.

29. The last paragraph of synopsis was added by me upon the inference of the narrator that his balloon acquired an ascensional power which awakened surprise, and respecting which, on reflection and consideration, he came to the conclusion that "*the electrical medium" in which he was floating was* acting on the gas and attenuating it."

30. In concluding an essay entitled "Additional objections to Redfield's theory of storms," published in Silliman's Journal about the year 1843, as well as on various other occasions, and especially in my two strictures on Espy's report, I have advanced that æriform particles, when existing in a mass of air electrified, either vitriously or resinously, must repel each other more than when they are in a normal

state; and, consequently, the mass which they constitute must be dilated proportionably to the intensity of the charge. Moreover, a mass so electrified must be repelled by the earth proportionably to the charge, so that in this way a diminution of barometrical pressure and atmospheric density may ensue.

31. But, according to Dalton's observations, the temperature being constant, the quantity of moisture in the air is as the space occupied by it, since it is the capacity of the space, not that of the air, which regulates the proportion of moisture associated with the latter.

32. It follows that when by electrical repulsion the air is dilated it will have an increase of its capacity for moisture, proportional to its dilatation, and when the electricity causing the increase of capacity is discharged the moisture must precipitate.

33. And further, when two masses of air, oppositely electrified, coalesce proportionably to the neutralization, must moisture be deposited?

34. Such masses must acquire by a reaction with the earth, and an ascensional tendency arising from repulsion between them and the terrestrial surface. Mr. Wise's observations respecting the influence of the electric medium upon the gas within his balloon, by which it was so attenuated as to create a surprising ascensional power, is altogether confirmatory of my inferences.

35. It appears that Mr. Wise was enabled to vary the direction of his sailing by varying the altitude at which he floated. Hence, as there are always two currents during gales, it would be possible for an aerial navigator to determine his course by his elevation, as Mr. Wise appears to have done. In a northeastern gale he might first use one current in order to go to a sufficient distance, and then use the other to return.

CORRESPONDENCE

ON

THE CLIMATE OF SAN FRANCISCO.

BY DR. H. GIBBONS.

No. 1.—GENERAL REMARKS.

Since the 1st of December, 1850, I have kept a record of observations on the weather in this city, of which I propose to give you a summary, for the especial benefit of distant enquirers. It may be well to observe, that while the climate of the western coast of North America possesses some peculiar features, that of San Francisco and the immediate vicinity differs from every other place on the coast, and is, in some respects, the most extraordinary climate in the world. This is owing to the peculiar position of the city, having the ocean on one side, and on the other a vast bay, extending north and south near a hundred miles, and separated from the ocean by a mountain wall, except at the break where the city is located, and where the bay communicates with the sea by a narrow strait. On the coast, a trade-wind from the northwest blows almost constantly, in the summer season especially, and a strong ocean current flows in the same direction.

The thermometrical observations forming the basis of the following summary were made three times a day, viz: about sunrise, which is the coldest period; at noon, or after, being the warmest period; and at eleven in the evening. In computing the mean temperature for the month, I have used two observations only, the extremes at sunrise and at mid-day; experience having shown that the mean thus calculated is very near the true temperature for the twenty-four hours.

In the Atlantic States, the warmest period of the day in winter is from one to two o'clock, and in summer from two to three. In San Francisco the same rule holds in winter but not in summer; for the sea breeze, which springs up about noon, or soon after, instantly depresses the temperature, so that the warmest time of the day, from May to August, inclusive, is an hour or two earlier than in winter.

For the want of proper care in the location of the thermometer, many of the observations which are thrown into print lose much of their value. The greatest error is commonly at mid-day, when the instrument is exposed to reflection from buildings and other objects on which the sun is shining. Every such object acts as a mirror, and tends to elevate the column of mercury above the proper mark for the air. The thermometer should, therefore, be excluded, not only from the direct, but also from the reflected heat of the sun, and it should at the same time be exposed to a free circulation of air; hence, to obtain a proper location is often very difficult. The figures in my observations will be found lower, in many instances, than those obtained by other observers, in consequence of the care exercised in this respect. In making the morning observation, I use a self-registering thermometer, which is certain to give the minimum temperature.

The summary, which I will now present, gives the mean for each month at or before sunrise, when it is the coldest, or at noon, when it is warmest, and at eleven in the evening; the mean temperature of the month, computed from two daily observations; also, the warmest and the coldest mornings in each month, and the warmest and coldest days at noon, with the range of the thermometer. It embraces a period of fourteen months—from December, 1850, to January, 1852, inclusive.

DECEMBER, 1850.—Sunrise 43.29 degrees Farenheit; noon 54.13; 11 p. m. 45.39. Monthly temperature 48.71. Coldest morning 28, warmest morning, 54; coldest noon 38, warmest noon 64; range 36.

JANUARY, 1851.—Sunrise 41.68; noon 56.94; 11 p. m. 44.90. Monthly temperature 49.31. Coldest morning 30, warmest morning 56; coldest noon 50, warmest noon 64; range 34.

FEBRUARY, 1851.—Sunrise 41.97; noon 60.03; 11 p. m. 43.64. Monthly temperature 51. Coldest morning 33, warmest morning 52; coldest noon 55, warmest noon 71; range 38.

MARCH, 1851.—Sunrise 44; noon 63.68; 11 p. m. 44.84. Monthly temperature 53.84. Coldest morning 34, warmest morning 50; coldest noon 53, warmest noon 74; range 40.

APRIL, 1851.—Sunrise 48.20; noon 67.27; 11 p. m. 49.80. Monthly temperature 57.73. Coldest morning 42, warmest morning 56; coldest noon 57, warmest noon 84; range 42.

MAY, 1851.—Sunrise 49.58; noon 64.32; 11 p. m. 50.42. Monthly temperature 55.95. Coldest morning 45, warmest morning 54; coldest noon 57, warmest noon 71; range 26.

JUNE, 1851.—Sunrise 50.90; noon 66.73; 11 p. m. 51.80. Monthly temperature 58.81. Coldest morning 49, warmest morning 56; coldest noon 60, warmest noon 78; range 29.

JULY, 1851.—Sunrise 51.50; noon 64.32; 11 p. m. 52.10. Monthly temperature 57.91. Coldest morning 47, warmest morning 54; coldest noon 60, warmest noon 73; range 26.

AUGUST, 1851.—Sunrise 54.97; noon 69.45; 11 p. m. 56.06. Monthly temperature 62.21. Coldest morning 50, warmest morning 66; coldest noon 63, warmest noon 82; range 32.

SEPTEMBER, 1851.—Sunrise 53.97; noon 69.27; 11 p. m. 54.20. Monthly temperature 61.62. Coldest morning 50, warmest morning 63; coldest noon 64, warmest noon 75; range 25.

OCTOBER, 1851.—Sunrise 53.36; noon 70.42; 11 p. m. 55.45. Monthly temperature 61.89. Coldest morning 47, warmest morning 60; coldest noon 60, warmest noon 83; range 36.

NOVEMBER, 1851.—Sunrise 48.93; noon 63.60; 11 p. m. 51.90. Monthly temperature 56.26. Coldest morning 41, warmest morning 57; coldest noon 52, warmest noon 73; range 32.

DECEMBER, 1851.—Sunrise 46.10; noon 56.55; 11 p. m. 48.26. Monthly temperature 51.32. Coldest morning 35, warmest morning 58; coldest noon 51, warmest noon 61; range 26.

JANUARY, 1852.—Sunrise 44.61; noon 56.97; 11 p. m. 49.39. Monthly temperature 50.79. Coldest morning 35, warmest morning 52; coldest noon 50, warmest noon 64; range 29.

For the year 1851: Sunrise 48.76; noon 64.38; 11 p. m. 50.28.

Yearly temperature 56.57. Coldest morning (January 17th) 30, warmest morning (August 18th) 66; coldest noon (January 9th) 50, warmest noon (April 28th) 84; range 54.

The average yearly temperature at Philadelphia is 51.50. Two degrees south of Philadelphia, in the latitude of San Francisco, it is near 54. It follows that the yearly temperature at this point of the Pacific coast is not much higher than on the Atlantic border. The vicinity of the Golden Gate is much colder in summer than any other point on the Pacific coast south of the Columbia river, owing to the almost incessant sea breezes, induced by the geographical features of the region round about.

The most striking peculiarity of the climate of San Francisco is its uniform temperature. There are no extremes of heat or cold. The warmest day in the year was the 28th of April, when the mercury reached 84; next to this was the 19th of October, 83. On the 18th of August it was 82, but this was *the only day in the three summer months* when it rose above 79! The thermometer was at or above 80 only on nine days in the year, six of which were in October. At Philadelphia, it reaches this point on from sixty to eighty days in the year.

Only once in the year did the mercury sink to the freezing point, and it was below 40 only on twenty-five mornings. At Philadelphia, it falls to the freezing point or lower about 100 times in the year.

The coldest day in the year, at noon, was 50. This is about equal to the *warmest* weather in the three winter months at Philadelphia. There, the months of January and February sometimes pass without one day as warm as this.

The warmest month in the year, at sunrise, was August, then September, then October. July, which is decidedly the hottest month in most other climates, was the fourth on the list, being considerably colder than October.

The warmest month at noonday was October; then August, September, April and June, in the order named. July comes in with May, being the sixth on the list, and only a trifle warmer at noonday than March and November.

At 11 p. m. August was the warmest, and next comes October and September, before July, which is but a trifle warmer at this hour than November. November was warmer in the evening than June.

The lowest temperature in the year being 30°, and the highest 84°, it follows that the range of the thermometer was 54°. On the Atlantic border, in the same latitude, the range is nearly 100°. At Philadelphia the greatest cold is 10° below zero, and the greatest heat 94°—making a range of 104°. At San Francisco, in December, 1850, the thermometer was one morning as low as 28°, and did not rise above 38° at noon, so that ice remained in the shade all day. This was regarded as an extraordinary degree of cold. Up to the present date, February 25, 1852, the extreme cold of the winter has been 35°, and it is probable the coldest weather is past.

January is the coldest month of the year in the Atlantic States, and February a trifle warmer. The same is true of San Francisco, judging from the past year. The temperature of January, at Philadelphia, is about 30½°, and that of July, the warmest month, 73½°; difference

43°. The difference between January and August, the coldest and warmest months at San Francisco, was not quite 13°!

To facilitate comparison, I insert the mean temperature for a series of years of the several months at Philadelphia: January, 30½°; February, 31¾°; March, 40°; April, 50°; May, 60½°; June, 69°; July, 73½°; August, 71½°; September, 64°; October, 53°; November, 42½°; December, 33¾°. By observing that one degree of latitude makes about one degree of difference in temperature in the Atlantic States, the reader may easily compute, from these data, the mean temperature at any given place. For example, if the place be two degrees north of Philadelphia, you will find its mean temperature by deducting two from the temperature at Philadelphia; if south, by adding.

The coldest month in 1851, at San Francisco, (viz: January,) was 9° warmer than the average of the coldest month at Philadelphia; while August, the warmest month at San Francisco, was 11° *colder* than the average of July, the warmest month at Philadelphia.

At San Francisco, the temperature falls more rapidly in the afternoon and evening than in the Atlantic States, but less rapidly during the night. From 11 P. M. to sunrise, the mercury at Philadelphia falls four or five degrees on the average, while at San Francisco the difference was less than two degrees, and in four of the months less than one degree; except in the winter, when the change is similar in this respect at the two points. In November, December, and January, at San Francisco, the thermometer falls from two to three and a half degrees between 11 P. M. and sunrise. The same is true precisely of Philadelphia. But while at Philadelphia in all the other months the fall during the same period of the night is twice as great, it is less than half as much at the former place. In other words, the temperature falls in the night, after 11 P. M., four times as much at Philadelphia as at San Francisco, from February to September inclusive.

In the summer months there is scarcely any change of temperature in the night. The early morning is sometimes clear, sometimes cloudy, and always calm. A few hours after sunrise the clouds break away, and the sun shines forth cheerfully and delightfully. Towards noon, or most frequently about 1 o'clock, the sea breeze sets in and the weather is completely changed. From 60° to 65° the mercury drops forthwith to near 50°, long before sunset, and remains almost motionless till next morning. This is the order of things in three days out of four in June, July, and August. May and September exhibit something of the same character, the sea winds establishing themselves in the former and declining in the latter month. This subject will be more fully investigated under the head of winds.

The remarkable uniformity of temperature at San Francisco may be further illustrated by taking note of the number of days in the year which give the same degree. The most frequent temperature at sunrise was 53°, the mercury standing at that point on forty-five mornings. The most frequent at noon was 64°, forty-two days showing that temperature. Referring to my journal kept at Philadelphia, I happened to open at the year 1839, which exhibits a fair representation of the climate there. I find the most frequent temperatures at sunrise were 52° and 68°, but that the mercury stood at each of these points on

fourteen mornings only. The greatest number of days in the year coinciding in temperature at noon was sixteen, with the thermometer at 68°.

At San Francisco, in the year 1851, there were one hundred and sixty-one mornings with the temperature from 50° to 54° inclusive. At Philadelphia the greatest number of mornings within the like range of the thermometer, in the year 1839, was but forty-six. At the former place there were two hundred and nineteen days within a range of 5° at noon, while the greatest number within that range at Philadelphia was but sixty.

It is not uncommon for the thermometer at noon to stand almost at the same point day after day, for one or two weeks. March, April, and October, were the most irregular months in this respect, being interspersed with a great proportion of warm days. But no other month of the year elapsed without exhibiting one or two weeks continuously when the mercury varied only 5°. From the 12th to the 26th February, (15 days,) the lowest mark at noonday was 55°, and the highest 60°. From the 2d to the 16th of June, (15 days,) the lowest was 65°, and the highest 70°. From the 1st to the 13th of July, (13 days,) the lowest was 61°, and the highest 65°; and from the 17th to the 27th of the same month, the lowest was 60°, and the highest 65°. In the first 13 days of August, the lowest was 63°, and the highest 65°—a variation of only 2°. From the 13th to the 21st of September, the lowest was 65°, and the highest 66°—only 1° of variation in nine days.—From the 2d to the 11th of November, (10 days,) the range was between 62° and 67°; and from the 14th to the 24th, (11 days,) between 60° and 65°. From December 8th to the 24th, (15 days,) the variation was from 54° to 58°—only 4°.

The sudden fluctuations of temperature incident to the climate of the Atlantic States are unknown here. We have none of those angry outbreaks from the northwest, which change summer to winter in a few hours. But the diurnal depressions of temperature in the afternoon are considerable. The average fall of the thermometer from noon to 11 P. M., for the whole year, is at Philadelphia 11°; at San Francisco 14°. The change at the latter place is the more striking, from its greater rapidity. In the season of the sea breezes, a few hours will reduce the temperature fifteen, twenty, and on some of the warmest days, twenty-five degrees; and this change is effected long before sunset. Under the head of *winds*, this subject will be more fully examined.

Comparing one day with that succeeding, the difference is never great. The greatest difference during the year at noon, between two adjoining days, was 21°. Turning to the table for 1839, at Philadelphia, in the month of March alone, three instances are found exceeding this: the differences being in one case 29°, in the second 33°, and in the third 35°. Though no other month was equal to March in this respect, yet there were several other examples during the year which exceeded the extreme at San Francisco.

As regards the influence of the seasons on vegetation, the common order is reversed. The entire absence of rain in the summer months parches the soil, and reduces it almost to the barrenness of a northern winter. The cold sea winds of the summer solstice defy the almost vertical sun, and call for flannels and overcoats. When the winds

cease, as they do in September and October, comes a delightful Indian summer. In November and December the early rains fall, and the temperature being moderate, vegetation starts forth, and midwinter finds the earth clad in lively green and spangled with countless flowers. The spring opens with genial warmth, but just as the April sun begins to give promise of summer heat, its rays are shorn of their power by the winds and mists of the Pacific.

These remarks apply only to a small portion of the State of California. Beyond the influence of the Bay of San Francisco and its outlet, the sea winds are scarcely perceptible, even near the ocean. In a subsequent chapter, I will present the results of my observations on the winds, clouds, rain, and other phenomena of the climate, as noticed at San Francisco, together with some notes on the climate of other portions of the State, and also its general relations to health.

NO. 2.—WINDS.

In a former article I gave the result of my observations on Temperature. The present chapter refers to the Winds.

The course of the wind is noted in my journal by three daily entries, viz: forenoon, afternoon and evening. Should the wind change during either of these periods, as it very often does, especially in the forenoon, the change is marked, and taken into account in the summing up. With these explanations, the reader will have no difficulty in comprehending the following table, which shows the winds of each month of the year, and the total of the year:

1852.	N.	NE.	E.	SE.	S.	SW.	W.	NW.
January	35	2	1	14	7	7	21	6
February	18	5	2	6	9	13	15	16
March	7	2	1	8	4	14	34	23
April	3	5	1	4	7	13	45	12
May	1	1	1	2	4	11	65	8
June	1	1	1	1	5	14	62	5
July	0	0	1	2	1	14	74	1
August	0	1	1	1	6	11	72	1
September	1	0	0	2	2	11	72	2
October	8	3	3	6	6	2	54	11
November	10	4	2	8	15	12	30	9
December	15	9	3	12	24	7	13	10
	99	33	17	66	90	129	557	104

The direction of the coast is nearly NW. and SE., or about one point north of NW., and one point south of SE. Hence the winds from NW. to S., inclusive, blow from the ocean, and those from N. to SE. from the land. The former greatly preponderate, exhibiting an aggregate of 880 observations, to 215 of the latter. That is to say, the winds blew from the ocean semi-circle more than three-fourths of the year.

It is still more striking that the winds came from due west, or rather from the octant corresponding to that point, more than half the year; the summing up of that column being 557 against 538 from all other points, embracing seven eighths of the compass.

Observe the remarkable contrast between the columns of west and east winds, the latter presenting only 17 observations in the year! It is a well ascertained fact that westerly winds predominate in the temperate latitudes of the northern hemisphere, on both continents. But I cannot discover that in any other spot on the globe the winds blow from one octant 186 days, and from the opposite octant only six days in the year.

Dividing the year into four seasons, January, February and December being classed as the winter months, we have the following result:

	N.	NE.	E.	SE.	S.	SW.	W.	NW.
Spring..........	11	8	3	14	15	38	144	43
Summer........	1	2	3	4	12	39	208	7
Autumn........	19	7	5	16	33	25	156	22
Winter..........	68	16	6	32	40	27	49	32

Thus it appears that the proportion of land winds to sea winds, in the several months, was as follows:

January,	land winds,	52	observations;	sea winds,	41	observations.
February,	do	31	do	do	53	do.
March,	do	18	do	do	75	do.
April,	do	13	do	do	77	do.
May,	do	5	do	do	88	do.
June,	do	4	do	do	86	do.
July,	do	3	do	do	90	do.
August,	do	3	do	do	90	do.
September	do	3	do	do	87	do.
October,	do	20	do	do	73	do.
November,	do	24	do	do	66	do.
December,	do	39	do	do	54	do.

Grouping the months into seasons, and reducing the observations to days, three observations representing one entire day, we find in the—

Spring,	land winds,	12	days,	sea winds,	80	days.
Summer,	do	3	do	do	89	do.
Autumn,	do	16	do	do	75	do.
Winter,	do	41	do	do	49	do.
Total,		72			293	

In every month of the year the sea winds exceed the land winds, except January, when the reverse occurred. In January, 1852, the land winds were 61, and the sea winds 32. In February, however, the former were but 27, and the latter 60. In December, 1850, the land winds exceeded the sea winds by one observation, the figures standing 47 to 46.

By casting the eye over the tables, one is struck with the progressive increase of the sea winds after the month of January, and the almost entire absence of the opposite winds from May to September, inclusive—the land winds in these five months occupying only six days.

The winds from north and east are always dry, and in winter cool.

They are nearly always attended with a sky of cloudless blue. Those from northwest to southwest are cold and chilling at all seasons, and in summer loaded with the ocean mists. But they do not often produce rain. The coast winds from south and southeast are most conducive to rain, and they are always warm. The course of the winds in relation to rain will be considered under the head of rains.

The force of the winds at different periods of the day, and from different points of the compass, is a subject of some interest. It is represented by figures—0 indicating calm or nearly calm, 1 a light breeze, 2 a moderate breeze, 3 a strong breeze or wind, 4 a high wind, and 5 a very high wind. The observations occupy three columns, for the forenoon, afternoon, and evening. The mean of each of these columns for every month is given in the following table, and the fourth column contains the mean of the three observations, collectively, for each month.

	Forenoon.	Afternoon.	Evening.	Mean.
January	1.21	1.45	.66	1.11
February	1.45	1.93	1.07	1.48
March	1.68	2.24	1.40	1.77
April	1.55	2.32	1.33	1.73
May	1.77	2.61	1.61	2.00
June	1.85	2.80	1.92	2.19
July	1.66	2.97	2.19	2.27
August	1.45	2.66	1.77	1.96
September	1.48	2.38	1.28	1.71
October	.87	2.05	.87	1.26
November	.85	1.22	.70	.92
December	1.37	1.32	1.07	1.25
1851	1.43	2.16	1.32	1.64

The reader will perceive that the average force of the wind in the afternoon was greater than in the forenoon, in every month of the year except December. By referring to my Philadelphia tables, I find there is no uniformity in this respect, the morning winds being stronger in some months, and the afternoon winds in others.

The evening winds were uniformly lighter than the afternoon, and lighter than those of the forenoon, except in the three summer months, when they were decidedly stronger than in the forenoon. At Philadelphia the evening winds sum up lower in strength than those of the forenoon or afternoon, in every month, without exception.

The table shows a remarkable progressive increase in the force of the atmospheric currents from January to July, the latter being the most windy month of the year; and then a decrease till November, the calmest month. At Philadelphia there is no such regularity. Autumn is the calmest season at both places, but summer comes next in the Atlantic States, then winter, and lastly spring, which is the windiest season on the eastern side of the continent.

From May to September, inclusive, there is more wind at San Francisco than at Philadelphia; but in the remaining five months, from October to April, there is less.

Not only in regard to time do the winds from the western semicircle greatly preponderate, but also in force. The land winds are often very

light and transient, not affecting an ordinary vane. Besides, many of the observations placed in this column in my journal are due to the influence of the bay, from which a gentle current—really a sea breeze—frequently flows upon the city for a brief period in the forenoon, before the general current from the ocean sets in from the opposite quarter. These bay currents are strictly local; and on the opposite side of the bay they take the opposite direction, and swell the proportion of sea winds in that location.

The following table is a summary of three daily observations, continued through the year 1851, showing the direction of the atmospheric currrents, with reference to their comparative force.

	N. & N.W.	E. & N.E.	S. & S.E.	W. & S.W.
Nearly calm	49	24	49	30
Light breeze	86	39	88	146
Breeze	69	5	36	335
Wind	20	0	13	191
High wind	2	0	2	29
Very high wind	0	0	3	1

Thus it appears that the wind was very high only on three days in the year. Much as is said of the violence of the wind at this place, I have never yet witnessed a wind in California equal to that which frequently attends a thunder-gust or an easterly storm of the highest grade in the Atlantic States.

From the east quarter of the compass the current did not rise beyond a moderate breeze in the entire year, and only for five observations did it reach that degree of force. As we recede from that limit, either northward or southward, the winds increase both in frequency and strength. But it is not until we pass the north point on one hand, and the southeast point on the other, that they are high. Of the twenty observations above noted as "winds" from the north and northwest, seventeen were from northwest, and only three from north. The two high winds under the same head were from northwest. So in regard to the thirteen winds, three high winds, and two very high winds, in the column headed south and southeast; a small proportion were from due southeast, the mass of them coming from south-southeast and south. The high winds of winter, when such occur, are from this quarter, and bring rain. The high winds of summer are always westerly, and without rain.

In the course of the year there were 169 windy days. On 123 of this number, the wind did not rise till after the sun had crossed the meridian, and it continued after sunset on 57 only. There were but 20 days in the year windy at sunrise.

The sea breeze of summer, which forms the most striking trait of the climate of San Francisco, demands something more than a passing notice, and will be reserved for another chapter, together with the subjects of clouds, rains, electrical phenomena, &c.

No. 3.—THE SEA BREEZE.

The tables contained in my last number exhibit the great excess of sea winds over land winds in every month of the year 1851, excepting January, when the excess was in favor of land winds. In this respect, the month of January in the present year corresponds with the last. December, 1850, shows a very slight preponderance of land winds. From these data I infer the general rule, that the westerly or sea winds predominate in every month except January and December, and that the latter month varies in this respect, being sometimes on the one side and sometimes on the other.

I have already stated that the westerly winds increase, both in frequency and in force, from February to July, and then begin to fall off very gradually. The precise relation of sea to land winds, in each month, as to frequency, is shown by computing their per centage of the whole number of observations. The result for the year 1851 is as follows:

January, sea winds		44	per cent.
February,	do.	63	do.
March,	do.	81	do.
April,	do.	86	do.
May,	do.	95	do.
June,	do.	96	do.
July,	do.	97	do.
August,	do.	97	do.
September,	do.	96	do.
October,	do.	78	do.
November,	do.	73	do.
December,	do.	38	do.
To which may be added—			
December, 1850, sea breeze		49	do.
January, 1852,	do.	34	do.
February, 1852,	do.	69	do.

Whatever may be the direction of the wind in the forenoon, in the spring, summer, and autumn months, it almost invariably works round towards the west in the afternoon. So constant is this phenomenon, that in the seven months from April to October, inclusive, there were but three days on which it missed, namely, on the 8th of April, the 18th of May, and the 27th of August. And these three days were all rainy, with the wind from the south or south-southwest.

The sea winds are moderate in the spring until the month of May, when they begin to give trouble. In June they increase in force, reaching their greatest violence about the beginning of July. In August they begin to decline in force, though not in constancy. In September they continue steady, though moderate; and in October they lose their annoying qualities, and become gentle and agreeable.

The sea winds of summer are commonly supposed to come from the northwest. But this is a great error, arising, no doubt, from the fact that our citizens have mostly been accustomed to cold winds, in the

Atlantic States, from that quarter. In the early spring they sometimes proceed from north of west. As the season advances they depart entirely from this course, and are almost invariably from south of west. From May to September, a period of five months, the direction of the afternoon sea breeze was north of west on twelve days only; and even on these occasions it was mostly within one point of west. The prevailing direction was west-southwest.

I have reason to believe that the wind off the coast, at sea, during the period referred to, is more northwardly than on land, and that it is deflected from that course about the bay of San Francisco. Such, at least, is the account given by the captains of vessels navigating the coast.

There was a decided sea breeze on 23 days in March, 17 days in April, 22 days in May, 24 days in June, every day in July and August, 28 days in September, 30 days in October, and 8 in November.

The number of afternoons that might be described as *windy* was, in February 8, March 16, April 15, May 18, June 24, July 29, August 23, September 19, October 8, November 2. On the 162 days thus noted, the mornings were seldom windy, the wind rising above a moderate breeze in the forenoon on 34 days only. In May there were 5 days windy at sunrise, and 1 in June; but not one in the months of April, July, August, September, and October.

The sea breeze generally rises to its height soon after noon-day, mostly between one and two o'clock, but sometimes not till three or four. It commonly falls about sunset, or soon after. Sometimes it continues till midnight. In the early part of the season it is apt to set in earlier and continue later. There were 8 windy evenings in May, 11 in June, 11 in July, 5 in August, and none in September.

The idea of mist and vapor is commonly associated with these winds; but the sky is clear, or partially so, more than half the time There were 6 cloudy mornings in May, 11 in June, 16 in July, 21 in August, and 22 in September. About 9 or 10 o'clock, the clouds mostly broke away rapidly, a light breeze springing up at the same time. Several hours of very pleasant weather occurred towards noon, almost every day. The sun shone forth with genial warmth, the mercury rising generally from about 50 at sunrise, to 60 or 65 at noon; but when the sun had reached the zenith, the wind rapidly increased, coming down in gusts from the hills, which separate the city from the ocean, and often bringing with it clouds of mist. But the dampness is never sufficient to prevent the elevation of clouds of dust and sand, which sport through the streets in the most lively manner. The mercury falls suddenly, and long before sunset it fixes itself within a few degrees above 50, where it sticks pertinaciously till next morning; often not moving a hair's breadth for twelve hours. Many times I have examined the instrument on suspicion that some defect had fixed the column immovably. The chilling temperature adds to the effect of sand and dust. Persons who have business out of doors are seen buttoning up their coats or overcoats, and rubbing industriously at the various apertures about the face as they hurry through the streets, in the worst possible humor. Such weather, at the summer solstice, with an almost vertical sun, is pronounced "perfectly ridiculous."

The mist often increases towards evening, and, when the wind falls, remains all night in the shape of a heavy fog. Sometimes, when the sun has been shining brightly, the mist comes in from the ocean in one great wave, and suddenly submerges the landscape. In a few minutes it may vanish, and give place to the cheerful sunshine. In short, there is no conceivable admixture of wind, dust, cloud, fog, and sunshine that is not constantly on hand during the summer at San Francisco. Not unfrequently you are tantalized with a rainbow at sunset. Once I saw a solar rainbow before night in the east, and soon afterwards another bow, in the west, made by the moon.

I have already noticed the almost constant prevalence of the west and southwest currents. As the sea breezes become established, the entire absence of winds from north and northwest is remarkable. In the month of May, and in the beginning of June, there were a few light breezes from that quarter. But from the 13th of June until near the middle of October, a period of four months, there is not a solitary observation noted in my record, even of the lightest or most transient wind, from north or northwest. I think it probable that the same cannot be said of any other spot on the globe, in the north temperate zone.

The uniformity of the summer weather is occasionally broken by the intervention of a few warm and pleasant days, when the wind is not high enough to convert summer into winter. Under these circumstances the thermometer mounts to 70 or 75. In the latter spring and early autumn months it is warmer. But as soon as the "summer" has fairly set in, flannels and firewood are in almost constant demand, at least until August.

No one but an actual observer can appreciate the utter impotency of an almost vertical sun during a brisk sea breeze. The rays of the sun have scarcely more warmth than moon beams. Instead of raising the thermometer 30 or 40 degrees, they seldom produce more than ten degrees of elevation in the sweep of the wind.

Such is the "summer" at San Francisco. Everybody complains of the chilly winds, the mist, and the dust. If you have nothing to do but sit in the house, you are perfectly comfortable. Even for out-door employment or exercise, the mornings are almost invariably pleasant. The evenings are generally too cool to sit without fire, and the nights are never too warm to dispense with blankets. For the purpose of rest and sleep, the night in California is perfectly luxurious all the year through. With sprinkled streets, the afternoons will lose much of their bad character at San Francisco.

It might be inferred that a climate such as I have described is unfavorable to health, especially with persons liable to diseases of the chest. But the fact is just the reverse. The tone and vigor given to the animal frame by the uninterruptedly bracing temperature, appear to raise it above the control of inherent tendencies to pulmonic disorders. I believe the humid and saline condition of the atmosphere co-operates in the benefit. But I shall consider this subject more fully under a distinct head.

In all other parts of California, except the region about the Bay of San Francisco, the summer is very different. Along the coast are mists and sea breezes, but the winds are moderate and not so chilling.

Inland, they do not extend beyond the barrier of hills which skirt the coast. A distance of fifty miles in any direction from San Francisco brings you into a different climate. In a southeast course, towards San José, you escape the winds and fogs of summer by travelling twenty or thirty miles. Even in Contra Costa, directly across the bay, they are less severe, though the trees show, by their semi-prostrate attitudes, the direction of the prevailing atmospheric currents.

The general principles on which depend the diurnal currents of air, which set in from sea to land, are well known. The land being more heated than the ocean by the sun's rays, the superincumbent heated air rises in a steady column. Its place must be supplied from some quarter, and the colder and denser air of the ocean accordingly flows in, constituting a sea breeze. Independently of this, we have the universal westerly current, coinciding in its course and tending to add strength and constancy to the sea breeze, while the topographical features of the Bay of San Francisco, and the region of country bordering on it, enhance the effect. These several causes combined will explain the extraordinary constancy and force of the westerly winds at this point.

The importance of these winds, in connexion with the climate of San Francisco, has led me to dilate much more than I intended in taking up the subject. There are other incidents of the climate yet to be considered.

No. 4.—RAIN, STORMS, CLOUDS, AND MISTS.

Mining and agriculture, the leading interests of California, are intimately connected with the distribution of rains. The absence of rain during one portion of the year, and its profuse supply during the remaining period, a phenomenon which maintains through a great extent of the western coast of the American continent, gives the subject additional interest as connected with meteorological science. These considerations induce me to enter into some details which may prove beneficial, although they may possibly not be so interesting to every class of readers. The prevailing idea of mists and fogs, and the relation of the climate to health, furnish additional reasons for some degree of minuteness in the investigation.

The subjoined table presents the following details, for each month, from December, 1850, to March, 1852, inclusive of both months.

1st. column. The number of days on which rain fell.

2d. The quantity of rain in inches.

3d and 4th. The proportion of clear and cloudy weather.

5th. The number of days clear, or nearly so, from sunrise to sunset.

6th. The number of days entirely cloudy, from morning to night.

7th, 8th, and 9th. The number of days misty in the forenoon, in the afternoon, and in the evening.

Months.	Days of rain.	Inches.	Proportion clear days.	Proportion cloudy days.	Whole days clear.	Whole days cloudy.	Misty, a. m.	Misty, p. m.	Misty eve.
1850.									
December.......	4	1.15	22	9	17	3	4	2	2
1851.									
January.........	4	0.65	24	7	12	1	8	3	5
February........	4	0.35	23	5	14	1	4	1	2
March..........	9	1.88	20	11	9	3	2	1	1
April...........	8	1.14	20	10	10	3	3	1	1
May............	3	0.69	23	8	15	1	0	0	2
June............	0		20	10	10	1	0	3	6
July............	0		20	11	9	0	1	6	19
August	1	0.02	21	10	10	1	0	2	9
September	2	1.00	23	7	7	0	2	1	2
October.........	2	0.18	26	5	15	0	2	1	3
November.......	5	2.14	23	7	13	2	2	2	4
December.......	15	7.07	19	12	10	5	1	0	0
1852.									
January.........	4	0.58	23	8	13	0	6	1	2
February........	4	0.12	21	8	5	2	5	0	0
March..........	14	6.40	19	12	9	4	2	0	0

It appears that the quantity of rain in the year 1851 was a small fraction over 15 inches. The annual quantity in the Atlantic States varies from 35 to 60 inches, with an average of about 45 inches. The driest season there gives more than double the amount exhibited in the foregoing table. So small a quantity as 15 inches falling in one year would be a terrible calamity to our Atlantic neighbors. It would involve the entire country in embarrassment, bankruptcy, and famine.

The winter of 1850–'51 was remarkably dry. Throwing it aside, and taking the year from the 1st of April, 1851, to the 1st of April, 1852, so as to include the rains of the following winter, we have 19.84 inches. I presume this figure is not very far from the mean of a series of years. But it is still much below the annual supply east of the Rocky Mountains.

It is well known that tropical countries have the most abundant rains, and that the quantity diminishes as you go northward. This is the general rule. On examining the records in my possession, scattered through a variety of publications, the smallest annual fall of water that I can find distributed in the Atlantic States or in the valley of the Mississippi, is at Burlington, Vermont, on the eastern border of Lake Champlain. The mean for a series of 13 years was 32.24 inches, and the least quantity in any one year was 26.35 inches, in 1849. In making these statements, the snow reduced to water is always included.

According to my own register, kept in Wilmington, Delaware, from 1827 to 1843, and at Philadelphia from that time till 1850, the least annual fall of water was 38.70 inches, in 1837, and the greatest 66.87 inches, in 1831.

The latter is an extraordinary supply for the middle States, but it is exceeded in the southern and southwestern sections of the country. It appears by a table published in the reports of the Patent Office, that there fell in Union county, Arkansas, latitude 33° 18′ north and longi-

tude 16° west of Washington, in the year 1850, not less than 81.37 inches. And this is not the maximum quantity in the southern tier of States.

Whether the rains in other parts of the State correspond in quantity with those of San Francisco, I am unable to say. I have taken measures to obtain exact information concerning this and other departments of the meteorology of California. But the only data of importance at present in my hand, consist of a journal for 1850 and 1851, kindly furnished me by Dr. R. V. Abbott, of the United States army, kept by him at Camp Far West, in the northern part of the State, latitude 39° 20′ north, longitude 121° 18′ west from Greenwich. From this record is taken the following account of the rain in each month of those years:

	1850.		1851.	
January	6.71	inches.	2.06	inches.
February	60	"	1.16	"
March	5.56	"	3.44	"
April	1.40	"	3.06	"
May	0.00	"	0.86	"
June	0.00	"	0.00	"
July	0.00	"	0.00	"
August	0.00	"	0.00	"
September	2.00	"	0.30	"
October	0.00	"	0.10	"
November	2.10	"	1.86	"
December	2.00	"	6.63	"
Total	20.37		19.57	

Thus it appears that the quantity which fell in San Francisco, in the year ending April 1, 1852, and which I have assumed as the probable annual mean, viz: 19.34 inches, corresponds very nearly with the annual supply for two years at Camp Far West.

In the two winters, or rainy seasons, embraced in my table, there were but four days on each of which the quantity reached one inch, viz: November 8, 1851, 1.50 inches; December 22, 1851, 2 inches; March 6, 1852, 1.20 inches; and March 8, 1852, 1.15 inches. These quantities bear no comparison with the rains of the Atlantic States. In almost every month of the year there are rains in that region from 1 to 3 inches in depth. The greatest quantity in a day at San Francisco was 2 inches. The heaviest rains at Wilmington, in each year, from 1830 to 1840, were as follows: 1830, 2.70 inches; 1831, 3.00; 1832 2; 1833, 3.35; 1834, 5.10; 1835, 2.70; 1836, 3.80; 1837, 2; 1838, 3.60; 1839, 3; and in 1840, 6.75 inches.

The last noted rain, in 1840, was nearly equal to the greatest monthly fall at San Francisco. That of 1834, being upwards of five inches, fell in the space of two hours. Compared with deluges such as these, the rains of California are but gentle showers.

The winter of 1849–'50, according to the representations of those who then resided here, was a season of continual ourpourings, not excelled since the forty days and forty nights of primeval times. They

tell us the water came down not in drops but in streams, and that the streets of the city were converted into flowing rivers and fathomless quag-mires. The tubs and casks that were left out at night were always found full and overflowing next morning. Unfortunately, there was no rain-guage to verify these statements. Doubtless the rains were copious at that time, probably much more so than since. But the doleful traditions respecting them may be referred in part to the absence of comfortable defences against the elements. The early settlers had to reside in tents, or beneath cribriform roofs, and tread in unplanked and submerged paths. These circumstances magnified and multiplied the falling drops, and penetrated the sufferers with indelible hydropathic impressions. Hence the rainy winter of 1849–'50 is uniformly dwelt on with great pathos and eloquence by those who endured it.

The question may arise, whether the floods that occurred in March, 1852, did not require a larger supply of rain than fell at San Francisco. But those who have not investigated the subject can form no adequate idea of the immense quantity of water requisite to make an inch of rain. Let us suppose the river Sacramento to drain a surface of one thousand square miles, and the channel at Sacramento to be 200 yards wide. Through this channel let one inch of rain be required to drain off in 24 hours, with a current of four miles an hour. It is easily calculated that one inch of rain, falling on a surface of one thousand square miles, would, under such circumstances, raise the river eight feet and keep it at that height 24 hours.

The presence of a few inches of snow, with the subjacent earth frozen, so as to prevent it from imbibing, will greatly enhance the diluvial effects of even a moderate rain. The snow, first absorbs the water and retains it until fully saturated, and then the entire mass rapidly liquifies and flows off. This was the case in the freshets that were precipitated from the mountains and hills of California in March last. One of the most destructive floods that ever occurred in eastern Pennsylvania was occasioned by a warm rain of less than two inches, which fell when the ground was frozen and covered with three or four inches of snow.

It is one striking feature of the winter of California, that when the weather puts on its rainy habit, the rain continues every day for an indefinite period; and when it ceases, there is an entire absence of rain for a long time. Thus, after three days of rain in the first week of December, 1851, the sky was perfectly clear for 13 days. Then, beginning with the 19th, rain fell every day for 13 days, or until the end of the month. After this it continued clear for nearly two months, there being but four slight rains in January, and two in February, until the 28th of the latter month, when the rainy diathesis again developed, and rain fell daily for 12 days. After the 10th of March, there were but four rains for more than a month.

There appear to be two rainy seasons, rather than one—something like the early and later rains of Palestine. The one takes place in the latter part of November or December, when the sea winds relinquish their sway, and the other in March, when they are about to resume their authority. Between those periods there is an interregnum of dry weather.

By adding together the number of rainy days in December 1850 and '51, and so of the corresponding months of the two seasons, the two rainy periods and the intervening period of drought are rendered more conspicuous.

December	1850 and '51.	Days of rain,	19,	quantity	8.23	inches.
January	1851 and '52.	"	8,	"	1.23	"
February	1851 and '52.	"	8,	"	0.47	"
March	1851 and '52.	"	23,	"	8.28	"

Thus in the four months embracing the early and later periods in the two seasons, there were 42 days of rain, and 16½ inches, while in the four intermediate months there were only 16 days of rain, and rather less than one inch and three quarters!

Dr. Abbott's journal, at Camp Far West, exhibits the same thing, though to a less extent. In that locality the early rains were continued into January. But February was a dry month. That the rule is general from year to year, the data are not sufficiently extended to warrant me in declaring; but the facts evidently tend to that conclusion. I am informed that the month of February was dry, in the memorable winter of 1849–'50, at San Francisco.

There were 53 days of rain in 1851, at San Francisco, and at Camp Far West, 62 in 1850, and 68 in 1851. In the Atlantic States the average number of days of rain in the year is about 100.

The average quantity of water for each day of rain at San Francisco, during the period embraced by the table, was about one fourth of an inch. At Camp Far West it was something more. The average in the Atlantic States is about twice that amount.

The rains in California are extremely irregular, falling almost invariably in showers. A settled and uniform fall of rain for twenty-four hours, or for even twelve hours, would be a strange occurrence. The southeast storms are the longest, but they seldom last many hours; or at least the rain does not, though the wind may continue. It seldom rains for two consecutive minutes with uniform rapidity. Often, in the space of one minute, there are several distinct showers. The sun breaks forth frequently in the midst of a shower, and directly the sky is almost clear. Presently, when you have no suspicion, you hear the rain on the roof with the suddenness of a shower-bath. These extemporaneous outpourings come from the west, and are always transient.

The night is more favorable to rain than the day. No matter how dense the clouds, how fair the wind, and how resolute the barometer in its promise of falling weather, the sun rarely fails to break up the arrangements towards noon, and to tumble the dense vapor into confused masses. I am informed by Robert Lammont, Esq., who was engaged in grading the streets of the city in the pluvious winter aforesaid, that the men in his employ were forced to suspend their labors for only four entire days in the whole time.

The entire season, with all its rains, is really delightful. It is not winter, but spring. The grass starts, and the flowers begin to blow on the hills as soon as the early rains have moistened the soil. In January nature wears her green uniform, studded with floral jewels. As spring advances the blossoms increase in variety and profusion, until their yellow

carpeting shows on the hills at the distance of five miles. With the drought of June comes the winter of vegetation.

I have something more to say in regard to the course of the winds and clouds during rain, and on the subject of mists and dews.

No. 5.—RAIN, STORMS, CLOUDS, AND MISTS.

In my last article I inquired whether moderate rains, such as have fallen at San Francisco, would be adequate to the production of the floods of last March; and I stated that a single inch of rain, poured into the river from a surface of 1,000 square miles, and forming a current of four miles an hour, would raise the river at Sacramento to eight feet, and keep it at that height 24 hours. When we consider that the Sacramento really drains something like 15,000 square miles, before reaching the city, we find no difficulty in accounting for the freshets without supposing an extraordinary fall of water. In the five days from the 5th to the 9th of March, there fell five inches of water at San Francisco. Suppose the same quantity throughout the State, and four fifths of it to sink into the earth, the remaining fifth, equal to one inch, running off, and requiring an entire week in the drainage. With a channel at Sacramento 200 yards wide, and a current of four miles an hour, the river would be raised *seventeen feet*, and kept at that height a whole week! With these data in mind, there is no difficulty in comprehending the great effects of even moderate rains in producing freshets, especially when the melting snows add to the supply.

The table contained in my last article shows that the number of days entirely or nearly clear, from sunrise to sunset, in the year 1851, was 134. This is not very different from the Atlantic States. At Philadelphia the number varies from 100 to 140, with an average of 125.

Owing to the many days that are partly clear, the number entirely clear does not present a criterion of the proportion of clear weather. By taking also into consideration the days that were clear in part, we find, as the table exhibits, the proportion of clear weather to cloudy, in the year, to be 262 to 103. The ratio at Philadelphia is about 220 to 145. The sky is therefore less clouded at San Francisco than on the Atlantic border.

I have already noticed the inconstant character of the clouds, the sky being seldom completely clouded for 12 hours, even in the rainiest period. The number of days in the year entirely cloudy, from the rising to the setting of the sun, was 18. At Philadelphia 50 is a very low number, and there are often 75. Seldom does any month of the year elapse in the Atlantic States without one or more days perfectly cloudy. At San Francisco there were but three such days in the six months from May to October. On most of the 18 days set down as entirely cloudy, the clouds were at times sufficiently broken to render the sun visible. It is an extraordinary circumstance for the sun to make his day's journey without showing his face.

The chilling mists of summer, conspiring with the wind and dust, leave on one's mind impressions not the most agreeable or evanescent;

but, after all, the weather is not so misty as might be supposed. By referring to the table given in my last paper, the misty weather appears to have been distributed as follows, in the four seasons of the year:

Winter...........	13	mornings,	5	afternoons,	7	evenings.
Spring...........	9	do.	3	do.	4	do.
Summer...........	1	do.	11	do.	34	do.
Autumn...........	6	do.	4	do.	9	do.

It should be noticed that the mornings were seldom misty for more than an hour or two after sunrise, and the afternoons not often misty throughout. The mist generally comes in detached clouds, driven by the wind, and sometimes in a universal stratum. Nearly always it gravitates sensibly towards the earth, in the form of a very fine rain, occasionally wetting the surface.

In the entire year there was mist on 27 mornings, 21 afternoons, and 45 evenings. At Philadelphia the average is about 20 mornings, 5 afternoons, and 10 evenings.

The tendency to the production of mist reaches its height in July. There were 19 foggy evenings in that month. The winter months, however, were most productive of mist *in the morning*. In the summer months there was but one foggy morning.

I now come to speak of the direction of the wind and clouds during the rains. In the sixteen months ending with March, 1852, and consequently embracing the greater part of two rainy seasons, there were 79 days on which rain fell, with the wind as follows:

East 0, northeast 2, north 2, northwest 6, west 8, southwest 17, south 20, southeast 24.

Or, the classification may stand thus:

East and northeast....................................	2
North and northwest....................................	8
West and southwest....................................	25
South and southeast....................................	44

Thus, from east and northeast, emphatically the rainy quarter in the Atlantic States, there was scarcely any rain. More than half the rains came from south and southeast. The rainiest point is in a direct line with the southern coast, or about south-southeast.

The easterly storms, which form so prominent a feature of the Atlantic climate, are unknown here. There is nothing that bears a resemblance to them. The rains from southeast are often attended by high gales, which extend over a large portion of the western coast of North America, and inflict some injury on shipping. But these gales are less violent than the most severe easterly storms of the Atlantic coast.

The direction of the cloud producing the rain is often of greater importance than that of the lower atmospheric current. There are mostly two strata of clouds, the lower concurring with the wind on the earth's surface, and seldom supplying rain, and the higher, which is the true rain-cloud, varying in its course from the lower, and sometimes having the very opposite direction.

In the 67 rains which furnished an opportunity of observing the upper cloud, its course was as follows:

Northeast	1
North and northwest	7
West	16
Southwest	23
South	14
Southeast	6

These results concur with observations made in the Atlantic States, showing that the higher strata of atmosphere which sweep northward from the equatorial region, saturated with aqueous vapor, are the principal source of rain in the temperate latitudes.

In the following table is recorded the number of days in each month on which clouds were observed in the lower and higher strata of atmosphere, the first column referring to the lower clouds, and the second to the higher. In the other columns is noted the direction of the higher clouds, as far as observed. The direction of the lower clouds, which mostly move with the wind near the earth's surface, is omitted.

Months.	Low.	High.	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.
1850.										
December	17	23	......	......	......	4	4	......	2	......
1851.										
January	15	29	......	......	......	......	3	8	10	......
February	19	21	......	......	......	......	3	1	1	7
March	24	28	......	......	......	......	4	8	8	3
April	24	22	1	2	......	2	......	15	1	1
May	26	24	......	1	2	......	3	8	......	2
June	26	15	......	......	2	3	......	3	1	2
July	28	8	......	......	......	1	1	4	......	1
August	28	17	......	......	......	......	2	14	......	......
September	29	14	......	......	......	......	1	8	4	......
October	20	24	......	......	......	......	7	6	3	5
November	20	27	4	......	1	1	3	2	4	7
December	19	31	......	2	......	5	5	7	4	7
1852.										
January	22	29	3	1	......	4	1	7	7	1
February	21	27	2	4	1	1	4	......	10	3
March	28	26	......	1	......	......	4	11	4	2
Total	......	......	10	11	6	21	44	112	49	41

The higher cloud was, in the majority of cases, a light cirrhus, often very partial, or seen only in the horizon, and composed probably of congealed vapor, at an elevation of two or three miles. In other cases it was a cirro-cumulus, or a nimboid-cumulus. In almost every month of the year, even during the dry season, the clouds put on the appearance of rain and then vanish. It is evident that the phenomena which produce rains in other climates are present in this, but not quite in sufficient degree to accomplish the result, except during the rainy season, and then only by paroxysms, with intervening periods of drought.

The table shows the presence of an upper cloud on 260 days of the year 1851, and a lower cloud on 278 days. The lower cloud was

deficient most frequently in the rainy season, but present almost daily in the dry season. The upper cloud was most wanting in the dry season, especially in July.

The higher currents of the atmosphere, as indicated by the clouds, pursue the same general course as in the Atlantic States. They show the prevalence of an almost constant stream from the tropical regions, traceable to the action of the sun, which heats and rarefies the air within the tropics, and causes it to ascend and pour over towards the poles. Starting northward, the current comes over portions of the earth having a slower rotary motion, and is thus deflected from a due north course, becoming a southwesterly instead of a south current.

No. 6.—REVIEW OF THE WEATHER FOR THE YEAR 1853.

The first part of January was cloudy and rainy, but after the 11th the weather was mostly clear and charming, only one rain occurring in the last two weeks. The lowest temperature was 41, and the highest 62. The mean at sunrise was 47½ and at noon 56½. The prevailing winds were very light from north and northwest. There were nine days entirely clear and four days entirely cloudy. January, 1852, was colder, having five mornings below 41; January, 1851, was much colder, having thirteen mornings below that point. Both these months were dry, scarcely any rain falling. But the first two weeks of January, 1852, were rainy; the remainder of the month dry. Sacramento city was drowned on the first of the month. In January, 1851, there was three-quarters inch of rain; 1852, half inch; and 1853, four inches.

February, for the first three weeks, the weather was superb. Up to the 21st there were no less than seventeen days entirely clear. In the last week there were four rainy days, but in the whole month only one day was entirely cloudy. The temperature was delightful, the means at sunrise and noon being 48 and 60. The coldest morning 42, and the warmest noon 67. The prevailing winds were from north, northwest and west, and most light. The hills were covered with flowers. In February, 1852, there were four mornings colder than in this month, and in 1851, thirteen colder mornings. February appears to be always a dry month. In 1851 there was one-third inch of rain; in 1852, half inch; in 1853, one inch.

March was mostly a pleasant month, with several moderate rains towards the middle, and three days of heavy rain in the last week. The prevailing winds were from west, northwest, and north, with an increasing tendency to west, and increasing force. The minimum temperature was 41, and the maximum 77; mean at sunrise 49½, and at noon 62. The first week of the month was very warm. On the 15th, Mount Diablo was covered with snow, as mostly happens towards the end of March. There is commonly considerable rain in this month. In the dry winter of 1851 there was two inches; in 1852, six and a half inches; in 1853, five inches.

April was a pleasant month, with winds generally from west and

northwest, and frequent light sea breezes. Temperature agreeable, varying from 46 to 56 at sunrise, and from 59 to 75 at noon; means at sunrise and noon 52 and 65. The heaviest rain for several years fell on the night of the 16th, viz: upwards of three inches in twelve hours. The only thunder of the season occurred during this rain. April mostly gives us some days of rainy weather. In 1851 an inch of rain fell; in 1852, only quarter of an inch; in 1853, five inches. The coldest morning was 46. In 1851 there were five colder mornings, and in 1852 eighteen. Dry and cold weather go together in our winters.

May was generally warm and pleasant; the coldest morning being 47 and the warmest 62, while the coldest noon was 61 and the warmest 81. The means at sunrise and noon were 53½ and 68. The wind settled in the western quarter, and increased in force, though not offensively high. There were several slight rains, with a large portion of cloudy and broken weather. The clouds always give their parting blessing in May. In 1851, there fell three fourths inch of rain; in 1852, one third inch; and in 1853, one third inch.

June was uncommonly warm; the mercury ranging from 49 to 60 at sunrise, and from 60 to 84 at noon. The sea winds were constant, but not often fraught with mist. The sky was unusually clear for summer.

The weather of July was uniform; varying in temperature at sunrise from 50 to 55, and at noon from 63 to 78. The means at sunrise and noon were 52½ and 68. Cloudy and misty weather prevailed, and there were but four days of clear sky from sunrise to sunset.

August was a cloudy and misty month; but less so than July. Its temperature also was very uniform, ranging at sunrise from 51 to 56 and at noon from 63 to 76. The means at sunrise and noon were 53 and 67. The sea winds, though constant, were not often high.

In the three summer months of 1851, there were four misty mornings and 33 misty evenings; in 1852, 7 mornings and 27 evenings; and in 1853, 15 mornings and 36 evenings misty.

September was rather pleasant, affording one or two days really hot. The morning extremes were 50 and 60, and the noon extremes 63 and 88. The sea winds continued their daily visits with diminished force; and there was much cloudy and broken weather, with two small rains near the middle of the month. The means at sunrise and noon were 55 and 70. September usually brings a day or two of light rain. One inch fell in 1851, a few drops only in 1852, and the eighth of an inch in 1853.

October was, as usual, warmer than several of the previous months. The coldest morning was 49 and the warmest 64; the coldest noon 60 and the warmest 85. The means at sunrise and noon were 54½ and 71. During this month the sea winds began to give out. The sky was generally fair; and one slight rain fell, amounting to 1-10 inch. In October, 1851, there was 2-10th inch; and in 1852, three fourths inch.

November placed the usual embargo on the sea winds. The temperature was moderate—a few slight frosts occurring. The coldest morning was 44 and the warmest 59; the coldest noon 55 and the

warmest 73. The means at sunrise and noon were 51 and 63. There was much cloudy weather, with occasional moderate rains. The prevailing winds were from west and south. The first southeasterly storm, in '51, was on the 8th; in '52, on the 13th; and in '53, on the 16th. Quantity of rain in the three years, respectively, 2 inches, 5½ inches, and 1½ inches.

December was more pleasant than common. The coldest morning was 40 and the warmest 54; the coldest noon 50 and the warmest 69. The means at sunrise and noon were 46½ and 57½. Hoar frosts were frequent; but the cold was not sufficient to injure vegetation. A copious rain fell on the 10th, and several light rains at other times. Prevailing winds from north, northwest, northeast, and south. Thunder was heard on the 10th, for the second time in the year. In December '50, there fell 1 inch of rain; '51, 7 inches; '52, 12 inches—the greatest quantity in any one month for three years and more; in '53, 2 inches.

The summing up for the year 1853 exhibits a mean temperature of 51½ at sunrise, and 65 at noon, which is warmer by two degrees than either 1851 or 1852. The lowest point reached by the mercury was 40—or eight degrees above the freezing point. The extreme of heat was 88. In 1852, the extremes were 35 and 98; in 1851, 30 and 84; and in December, 1850, the thermometer fell as low as 28. The amount of rain in each month of 1853 was, in round numbers, as follows: January, on eight days, 4 inches; February, four days, 1 inch; March, six days, 5 inches; April, eight days, 5 inches; May, three days, ½ inch; June, July, and August, none; September, two days, ½ inch; October, one day, 1-10 inch; November, eight days, 1½ inches; December, six days, 2 inches; making, in the year, forty-four days on which rain fell, to the depth of 19 inches. In 1851, there was rain on fifty-three days—quantity, 15 inches; in 1852, on sixty days—quantity, 25½ inches. From the first of January, 1853, to the dry season, the quantity was 16½ inches; and from the dry season to the end of the year, 3½ inches. The last rain of the spring was May 24th, and the first of the autumn was September 15th. The hills began to look green in the last week of November, and at the close of the year at least thirty species of plants were in bloom around the city, some of them the lingering flowers of summer, and a few the products of a new growth. There were two small specimens of thunder during the year, none of the aurora borealis, and a considerable sprinkling of meteors in the second week of August, and also in the fourth week of November.

No. 7.—THE WEATHER OF FEBRUARY, 1854.

The subjoined figures will enable the reader to compare this month with the corresponding months of 1851, 1852, and 1853:

	1851.	1852.	1853.	1854.
Mean temperature at sunrise	41.97	45.69	48.18	47.93
Mean temperature at noon	60.03	60.41	60.07	59.21
Mean temperature at 10 o'clock p. m.	43.64	49.59	51.00	49.07
Monthly temperature	51.00	53.05	54.13	53.57
Maximum	71.00	65.00	67.00	69.00
Minimum	33.00	40.00	42.00	38.00
Range	38.00	25.00	25.00	31.00
Clear, (proportion,)	23 days.	21 days.	22 days.	15 days.
Cloudy, (proportion,)	5 days.	8 days.	6 days.	13 days.
Whole days clear	14 days.	5 days.	17 days.	5 days.
Rain on	4 days.	4 days.	4 days.	13 days.
Quantity	0.35 inch.	0.12 inch.	1.16 inch.	8.41 inch.
North and northwest winds	9 days.	6 days.	10 days.	8 days.
Northeast and east winds	2 days.	3 days.	1 day.	2 days.
South and southeast winds	5 days.	4 days.	8 days,	8 days.
Southwest and west winds	12 days.	16 days.	9 days.	10 days.
High winds	0 days.	0 days.	0 days.	1 day.

The temperature of the month was about the medium standard. At sunrise it was not nearly so cold as 1851, but at noon it was rather below either of the other years, owing to the large number of cloudy and rainy days, which are apt to be cool at noon. On three or four mornings there were slight frosts. In the middle of the month, and again on the 28th, the coast mountains were seen covered with snow, as they mostly are when the rains at this point are accompanied with a temperature below 50. The most extraordinary feature of the month was the quantity of rain. February is usually a dry month, but this year it was the exact reverse. In February, 1851, the quantity was 0.35 inches; February, 1852, 0.12 inches; February, 1853, 1.16 inches; making in three months an aggregate of 1.63 inches, or less than one-fifth of the supply for the month just past. In the three years just mentioned, the greatest monthly supplies of rain were as follows: December, 1851, 7.07 inches; March, 1852, 6.40 inches; November, 1852, 5.31 inches; December, 1852, 11.90 inches; April, 1853, 5.05 inches. Thus it appears that February of the present year exceeded any other month in that period, except December, 1852.

Up to the first of March, the quantity of rain since the dry season was 16.26 inches. At the same date in 1851, the quantity was 3.40 inches; in 1852, 11.11 inches; and in 1853, 23.28 inches. The rains of this winter, therefore, though much greater than those of 1851 and 1852, have been but little over two-thirds of last winter's supply at this date. Subsequent to this date in 1851, and before the dry season, rain fell on twenty days, quantity 3.71 inches; in 1852, on eighteen days, 6.89 inches; in 1853, on seventeen days, 10.18 inches. From these data we may infer that our rains are by no means at an end.

Owing to the cold and wet weather, vegetation is very backward, having scarcely moved since the first of January. On the 15th of February, 1852, I found sixteen species of plants in bloom on the hills west of the city; and on the 22d I gathered forty-three species on a walk to the fort at the entrance of the bay. Last year, also, the country was covered with flowers in February. But this spring scarcely a flower has made its appearance. The spring of 1851 was equally backward, on account both of cold and of drought.

No. 8.—THE CLIMATE OF SAN FRANCISCO FOR THE YEAR 1854.

The year began with very fine weather. On the fifth was a severe norther, which damaged the shipping in the harbor. A few cold mornings followed, and on the 12th the rains set in. From that date to the 24th, rain fell on nine days to the depth of four and a quarter inches. The rains were cold and several times accompanied with hail, and snow covered the distant mountains. The coldest weather on my record was at this time. On the 19th, 20th, and 21st, the thermometer stood at 31, 25, and 31. At noon on the 20th it rose no higher than 37. The mud was frozen solid so as to bear the heaviest wagons. Of course, the oldest inhabitant had never seen the like. In December, 1850, it was nearly as cold, the mercury then falling to 27. The month wound up with a few very warm days. The mean temperature at sunrise was 42.26, at 9 A. M. 45.71, at noon 54.23, at 10 P. M. 45.26, being the coldest month on my book; that is, since the winter of 1849–'50. The greatest heat was 69, and the extreme of cold 25. The prevailing winds were north, northeast, and northwest.

It should be mentioned, as a rare phenomenon, that hail fell on the morning of the 15th so as to cover the ground and to lay for an hour. In the winter of 1849–'50 the ground was covered with hail or snow in like manner.

February was rather warm. The mean at sunrise was 47.93, at 9 A. M. 50.86, at noon 59.21, and at 10 P. M. 49.07. The extreme of heat was 69, of cold 38. Rain fell on no less than thirteen days, and in the quantity of 8.41 inches—the greatest quantity in any month on my record, excepting December, 1852, when there was nearly twelve inches. This is the more remarkable as February is usually a dry month. On the 12th, hail fell in a heavy shower so copiously that it could be gathered by the bucketfull where it collected from the roofs. The prevailing winds were from west, south, northwest, and north, in the order named as to frequency. Our high wind occurred from south-southeast.

March was of moderate temperature. The mean at sunrise was 47.23, at 9 A. M. 52.06, at noon 60.97, at 10 P. M. 49.45. The extreme of heat was 72, of cold 38. Rain fell on ten days 3.17 inches—a moderate supply for March. Most of the rain was during a cold storm on the 13th, 14th, and 15th, the wind blowing moderately part of the time from northeast, which is a rare direction for a rain wind. The westerly winds increased in frequency, as usual in this month. Those

from south, northwest, and north, divided among them one half the month. There were no high winds.

The warmest April on my book was that of 1854. The mean at sunrise was 51.10, 9 A. M. 59.83, noon 68.43, 10 P. M. 52.90. The extreme heat was 83, of cold 45. Rain on 6 days, 3.31 inches, nearly two inches of which fell on the 28th,—the last rain of the season. The sea breeze came nearly every day, though with moderate force. On 10 days the winds were from other quarters than west. During this month the hills and fields assumed the gorgeous array of flowers which marks a California landscape in the spring.

May was a very unpleasant month, cold and windy, often cloudy and threatening rain. On one day only was there rain, and then but two-hundredths of an inch, in the form of mist. The mean temperature at sunrise was 48.95, at 9 A. M. 59.00, at noon 64.61, at 10 P. M. 50.68—being three degrees below April. The mercury rose no higher than 73, and the lowest extreme was 43. There were light frosts on several mornings, and vegetation advanced tardily. Potatoes of the season's growth appeared in the market on the 1st. A hail storm occurred at Sacramento on the 6th. The winds were westerly on 25 days. On 8 days they were high.

June, also, was a cold month, rather below April in temperature. Mean at sunrise 50.10, 9 A. M. 61.83, noon 66.80, 10 P. M. 51.50. The warmest day was 74, and the coldest morning 47. There was an unusual tendency to rain, and several times a few large drops deigned to violate the law of the season. On the 17th it rained moderately for two hours, four-tenths of an inch collecting in the guage. On the 13th was a heavy storm of rain and hail in Utah. On 23 days the wind was west, and on four northwest. It was high on eight days.

July was rather above the average temperature. The means were, at sunrise 51.87, 9 A. M. 63.94, noon 70.65, 10 P. M. 54.16. In the three years preceding, the mercury had not reached 80 in July, but in this year it was at or above 80 on four days, and on one day as high as 87, which is near the extreme heat of our climate. The lowest extreme was 46. The first week was beautifully clear, but afterwards there was scarcely a morning or evening without cloud and mist. The wind was constantly west, and on six days it was high.

August was a trifle below the average temperature. Mean at sunrise 52.42, 9 A. M. 62.39, noon 68.29, 10 P. M. 53.81. There were two days above 80, the highest being 85. The minimum temperature was 50. Almost every afternoon was windy, and though the wind was high on one day only, yet the weather was about as unpleasant as our summer climate can afford. The mornings were generally cloudy and the evenings misty. A light shower of rain fell on the 27th. At Los Angeles and San Diego it rained heavily on the 20th and 21st, and on the Trinity river there was a thunder storm on the 26th, with heavy rain and snow on the mountain peaks.

September, commonly the warmest month in the year, was nearly as cold as August. Mean at sunrise 53.30, 9 A. M. 61.43, noon 67.73, 10 P. M. 54.40. There were two warm days, on one of which the mercury rose to 87. The greatest depression was 46. Cloudy mornings and misty evenings prevailed, and the sea breeze blew with great

constancy and with more force than usual in September. This month seldom passes without rain, but on the present occasion the only rain was a trifling shower on the 15th. There was a heavy rain at Los Angeles about the same time.

The weather of October was generally agreeable. Mean temperature at sunrise, 53.32; 9 A. M., 60.97; noon, 68.13; 10 P. M., 55.42. There were three days above 80, the warmest being 83. The minimum temperature was 46. It was the warmest month of the year, except July. The winds were light, and distributed to west, northwest, north, and south, the first predominating. The most extraordinary feature of the month was its frequent rains. Rain fell on no less than 10 days; quantity 2.12 inches. The first rain was on the 4th. At Marysville the ground was covered with hail on the 23d. At the close of the month the hills around the city began to look green, and the wise men predicted a very rainy winter.

The climate of November was very fine. Mean at sunrise, 50 67; 9 A. M., 55.97; noon, 65.13; 10 P. M., 53.00. The extremes were 72 and 47. The mornings ranged from 47 to 55, and the noondays from 58 to 72. The winds were from west, northwest, and north, and gentle as zephyrs. The sky was almost uninterruptedly clear. A single rain fell, amounting to four tenths of an inch; and the wise men reversed their prediction and promised a very dry winter instead of a wet one.

December furnished a continuation of the fine weather of November, with a decline of temperature corresponding to the season. Mean at sunrise, 47.03; 9 A. M., 51.32; noon, 60.65; 10 P. M., 49.39. There were a number of slight frosts, and ice formed in favorable situations, though the minimum temperature was 38. The warmest day was 71. The most gentle breezes prevailed from north, northeast, and northwest. There were 15 days entirely clear. A trifling rain, .08 inches, fell on the 3d, and no more until the 31st, when a rain storm set in, which was quickly handed over to the new year, leaving three tenths of an inch to December.

The mean temperature of the whole year sums up as follows: Sunrise, 49.68; 9 A. M., 57.11; noon, 64.57; 10 P. M., 51.76. The mean of the sunrise and noon observations gives the figure for the year, 57.13. The temperature for 1851, deduced in the same way, was 56.57; 1852, 56.53; and 1853, 58.51. The year 1853 appears to have been unusually warm. Taking 1854 as a fair representation of the climate of San Francisco, it follows that our climate is two or three degrees warmer than that of the corresponding latitude on the Atlantic coast, though it does not exhibit the extremes either of heat or cold incident to the latter.

The extreme of heat in 1854 was 87. There were only twelve days in the year at or above 80, of which one was in April, four in July, two in August, two in September, and three in October. In 1851 there were nine days at or above 80; in 1852, thirteen; and in 1853, eleven.

The extreme of cold was 25. There were three days in the year when the mercury fell to the freezing point, all in January. In 1851, the thermometer fell to the freezing point on one day only; in 1852, 35 was the lowest depression; and in 1853, it did not sink below 40.

The warmest month in the year was July, then October, then Sep-

tember, then August, then April and June stands the sixth in order, and only two degrees above November. In neither of the three years preceding was July the warmest month. In 1851 the warmest months occurred in the following order: August, October, September, June, July, April. In 1852: September, July, August, June, October, November. In 1853: October, September, June, May, July, August. To the [illegible] winds in the summer is owing this great variation from the order of the months as to comparative temperature in other climates.

January was the coldest month, then February, then December, and next March. In other years, December sometimes takes the precedence of January. February, which in the Atlantic States is often the coldest month in the year, is not so here.

Rain fell on 54 days in the year, 22.12 inches in depth. This is our average supply, though only half the quantity that falls in the Atlantic States. In 1853, the quantity was [illegible] inches; in 1852, 25.60 inches; and in 1851, only [illegible] inches. The old inhabitants tell of occasional seasons when scarcely any rain has fallen, and when the cattle have perished from want. Such very dry seasons are said to recur at intervals of eight or ten years.

The greatest amount of rain was in February, next comes January, next April, then March. This differs from the ordinary arrangement. Taking the last four years into view, December gives the most rain, and March comes next, while the intervening months are comparatively dry. In fact, we have the early rains, beginning in November and continuing through December into the early part of January; and the later rains, beginning in March, and continuing at times through April.

Lightning is seen at San Francisco on an average three or four times a year, and thunder is heard less frequently. On the 15th January, flashes of lightning were observed in the evening, during a cold rain storm from the south; and on the 22d February, under similar circumstances, lightning was again noticed. But no thunder was audible in either case; nor was there any further exhibition of atmospheric electricity during the year. There was thunder three times in 1851, five times in 1852, and twice in 1853.

No exhibition of auroral light was observed in the year. Since my residence here, from August, 1850, I have seen the aurora borealis only on two occasions, once in January and once in February, in the year 1852.

There was no unusual display of shooting stars during the year. In September, 1851, in August, 1852, and in August, 1853, they were numerous for several nights in succession.

Earthquake shocks were distinctly felt on the mornings of the 9th of January and 21st of October.

Abstract of Meteorological Observations for Sacramento, California, latitude 38° 34′ 42″ north, longitude 121° 40′ 5″ west; elevation above the level of the sea 30 feet; for the year ending March 31, 1854. By Thomas M. Logan, M. D.

1853–'54.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	Mean.
Barometer.													
Maximum	30.38	30.28	30.20	30.20	30.05	30.10	30.40	30.45	30.45	30.45	30.40	30.40	30.45
Minimum	29.88	29.88	28.88	29.95	29.85	29.90	29.90	29.30	29.70	29.70	29.70	29.85	28.88
Mean	30.13	30.09	29.79	30.06	30.30	29.85	30.15	30.05	30.13	29.11	30.17	29.05	29.97
Thermometer.													
Maximum	76	78	97	93	93	95	88	72	64	59	62	68	97
Minimum	50	54	58	62	58	54	58	46	32	19	38	37	19
Mean	61	68	77	75	71	76	73	53	48	43	51	53	62
													Total.
Clear days	16	19	27	25	22	28	26	13	21	19	10	13	239
Cloudy days	7	6	2	2	8	1	4	10	6	5	5	9	66
Rainy days	7	6	1	4	..	1	1	6	4	7	13	9	59
Days of Wind.													
North wind	3	2	3	..	..	..	1	..	2	4	3	4	22
Northwest wind	8	7	13	4	1	9	23	13	16	16	10	8	128
West wind	1	..	..	..	..	..	1	..	1	1	1	2	7
Southwest wind	7	10	7	2	3	5	3	4	2	1	1	5	50
South wind	3	4	4	1	2	4	1	5	1	3	1	8	37
Southeast wind	7	7	3	24	25	9	2	5	2	5	6	1	96
East wind	1	1	..	..	..	1	..	3	2	..	4	1	11
Northeast wind	..	..	..	..	..	2	..	..	4	1	4	2	13

REMARKS.—By clear days is meant that no clouds were visible at the times of observation; by cloudy, that some were visible; and by rainy days, that some rain fell then, without reference to quantity. Not being provided in time with a suitable pluviometer, the quantity of rain cannot be put down in figures. The greatest amount that fell at any one period was on the 22d February, after raining forty-eight hours without intermission. The last rain of the past season occurred on the 20th May, 1853. There was a slight sprinkle afterwards on the 26th June, and on the 17th and 21st July. The first rains of the present season occurred on the 15th September and 10th October. The regular rainy season, however, did not set in until the 14th November. About the middle of January the coast-range of mountains presented the novel appearance of being covered with snow. The degree of cold during this month was unprecedented. Not having a thermometrograph, the minimum, which generally occurs shortly before sunrise, may not have been obtained. Sutter lake was frozen over on the 6th and on the 21st of January, and remained so all the day of the 22d. This degree of cold is one of those extraordinary occurrences which is sometimes experienced in the most equable and genial climates. Thus, for instance, in 1507 the harbor of Marseilles was frozen over its whole extent; for which a cold of at least 0.4° was requisite. Again, in 1709, the Gulf of Venice, and harbors of Marseilles, Genoa, and Cette, were frozen over. Such irregular occurrences are caused by the long prevalence of particular winds, and should not be taken into computation in making an estimate of the mean annual temperature of any place. Notwithstanding, however, even the past extraordinary winter, we find the mean annual temperature of Sacramento vieing with the land of the olive and the vine. An isothermal line drawn across our continent, from this point, would deviate as many degrees to the south as from the western to the eastern side of the old continent.

Meteorological table for Sacramento, California, for the year ending March 31, 1855. By Thomas M. Logan, M. D.

1854–'55.	April.	May.	June.	July.	August.	Sept'r.	October.	Nov.	Dec.	Jan.	Feb.	March.	Mean.
Barometer.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.
Maximum	30.45	30.28	30.22	30.13	30.20	30.20	30.20	30.35	30.26	30.34	30.11	30.04	30.45
Minimum	29.85	29.	29.90	29.85	29.80	29.85	29.83	30.05	29.68	29.44	29.50	29.52	29.
Mean	30.04	30.02	30.03	30.08	30.05	30.04	30.13	30.21	29.69	29.95	29.78	29.72	29.98
Thermometer.	°	°	°	°	°	°	°	°	°	°	°	°	°
Maximum	78.	77.	90.	101.50	99.	90.	90.	72.	68.	62.	70.	76.	101.50
Minimum	49.	48.	49.	50.75	52.	48.	49.	44.	29.	27.	32.	41.	27.
Mean	60.	62.	67.	80.63	69.47	65.05	60.01	55.05	47.93	43.71	52.50	54.82	59.84
Dew Point.	°	°	°	°	°	°	°	°	°	°	°	°	°
Maximum	....	....	....	68.	62.50	55.	55.	49.50	49.	44.50	51.50	59.	68.
Minimum	....	....	....	45.50	43.	40.50	32.	34.	25.50	30.	18.	32.	18.
Mean	....	....	....	61.59	50.22	48.20	45.40	42.65	39.	38.08	41.37	45.13	34.30
Number of—													Total.
Clear days	9	23	20	27	25	26	12	20	19	8	16	10	215
Cloudy days	12	4	7	4	5	3	10	8	9	18	3	13	96
Rainy days	9	4	2	....	1	1	9	2	3	5	9	8	54
Inches of rain	1.50	0.21	0.31	....	0.0½	sprinkle.	1.01	0.65	1.15	2.67	3.46	4.20	15.16½
Days of—													
North wind	1	1	⅓	2⅔	⅔	1⅔	2⅓	6⅔	3	2⅓	4⅓	2	28
Northwest wind	10	6	6	4	2⅓	2	7⅔	12⅔	17⅔	13	10	10⅔	102
West wind	1	1	⅓	11⅓	1	3⅓	⅔	1⅓	⅓	⅔	....	1	22
Southwest wind	8	8⅓	7⅔	7⅔	8	10⅓	8	3⅓	....	3	5	5	74⅓
South wind	5	8⅔	10	5	8	5	3⅓	....	1	1⅔	2	3⅔	53⅓
Southeast wind	3	3⅔	3⅔	....	10⅔	7	7⅔	2⅓	4⅓	6⅓	6	8	62⅔
East wind	⅓	1⅓	1	....	⅓	⅔	⅓	1	3	1⅓	⅓	⅓	10
Northeast wind	1⅔	1	1	⅓	....	....	1	2⅔	1⅔	2⅔	⅓	⅓	10⅔

REMARKS.—By clear days is meant that no clouds were visible at the times of observation; by cloudy, that some were visible; and by rainy days, that some rain fell, without reference to quantity. The heaviest rain of the year commenced falling at noon, on the 27th February, and continued without intermission until 10, P. M., of the 28th, measuring 2.10 inches. The last rain of the past season occurred on the 17th June, 1854, and amounted to 0.20 inches. The first rain of the present season was on the 4th October, when 0.14 inches fell. Thus far the present has been a comparatively dry season. The Sacramento river remained at a very low stage until 15th March, when it rose 20 feet 2½ inches above low-water mark; since which time it has been gradually falling. The 13th July was the hottest day experienced during the year, and, indeed, since the settlement of the country. The thermometer was observed, in some less favored situations than ours, at 107°, at the hottest time of the day. The mean temperature of the hottest part of the day for the week ending July 15th was 97°. The night of the 16th August was the hottest as yet noticed in the country; the thermometer standing at 82° at 10 o'clock, P. M., and 70° at sunrise. The weather during the whole winter was mild, dry, and pleasant; and the spring opened early. On the 1st February, the cowslip was observed in profuse blossom on the surrounding plains; on the 15th, the wild violet; on the 20th, the peach tree; and on the 23d, the willow (*salix nigra*) and the nemophila, a small indigenous blue flower.

Meteorological Observations at Sacramento, California, lat. 38° 34′ 42″ *north, long.* 121° 40′ 05″.

BY F. W. HATCH, M. D.

The observations with the thermometer and barometer, and record of the winds, embrace a period of ten months, from June, 1854; and those of the psychrometer, the period embraced between August, 1854, and March, 1855, inclusive. The means of the thermometer are calculated from four daily observations, viz: at sunrise, (for which the minimum is used, at noon,) at sunset, and 10 P. M.; those of the barometer, from three daily readings, at sunrise, noon, and 10 P. M; and the same number for the psychrometer, but at different hours, viz: at or near sunrise, 3 P. M., and 10 P. M. The course of the wind is given four times daily, corresponding with the observations of the thermometer, and will serve to show the influence of the wind, both upon the elevation of the barometer and the humidity of the atmosphere. A long and patient examination and system of comparison, upon this subject, has convinced me of the almost perfect uniformity of a high barometer and a northerly wind, (north or northwest,) and the reverse condition with a south or southeast wind. There are some exceptions to this rule, and in our northwest gales the barometer often falls low; but what I have stated is the *ordinary* course under *ordinary* conditions. The source of these winds in the mountains of Oregon, and of the others (south, southeast, and southwest) from the Pacific, will, moreover, account for their respective influence upon the humidity of the atmosphere.

Not less evident is the relation of the winds to temperature, especially in the summer months. It is common, at this season, for the wind, after sunrise, to change to a northerly direction, and to continue in this quarter for a greater or less length of time, varying from a few hours to a period of the day as late as 3 or 4 P. M. In their passage over the burning plains of the interior, and by contact with the heated air, they have acquired, before they reach here, an elevated temperature, and are dry and occasionally hot. This state of things is, however, mostly succeeded by a delightful breeze from the ocean in the afternoon, when both the temperature and the humidity of the atmosphere undergo a rapid transition. These facts would be more clearly denoted by an examination of the daily record, and especially by a separate observation in the forenoon, than by the *means* which I send, inasmuch as the northerly wind of the morning is frequently unnoticed in my *regular tables*, from the fact of its prevalence only between the hours of sunrise and noon. The above is a correct view of the ordinary course of the wind in the summer season. In the winter, on the contrary, the north wind prevails more, and comes to us in all its original freshness and coolness.

TABLE No. 1.—*Of daily and monthly means of the Barometer at Sacramento, Cal., from four daily observations from June, 1854, to March, 1855, inclusive.*

Days.	1854, June.	July.	August.	September.	October.	November.	December.	1855, Jan'ry.	February.	March.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1	30.026	29.850	30.023	29.880	30.036	30.123	30.086	29.553	29.903	30.156
2	30.080	29.960	30.036	29.840	30.036	30.100	29.936	29.963	30.020	30.110
3	30.050	29.953	29.940	29.866	29.880	30.263	29.986	29.916	30.206	30.146
4	29.980	29.870	29.973	29.910	29.790	30.223	30.080	29.683	30.236	30.080
5	29.940	29.833	30.003	29.866	29.880	30.130	30.156	30.010	30.076	30.040
6	29.973	29.830	29.993	29.860	30.016	30.036	30.22	30.283	29.943	29.956
7	30.130	29.875	30.026	29.910	29.973	29.983	30.203	30.260	30.070	30.066
8	30.006	30.003	29.893	30.033	29.830	30.003	30.156	30.240	30.160	30.060
9	29.943	30.060	29.883	29.983	29.866	30.036	30.216	30.273	30.250	29.983
10	29.923	30.046	30.033	29.930	29.920	30.106	30.41	30.273	30.093	29.923
11	29.913	30.036	30.046	29.923	29.966	30.090	30.406	30.110	30.216	29.916
12	29.933	29.963	29.976	29.940	29.930	30.073	30.29	30.076	30.203	29.770
13	29.873	29.873	29.960	29.980	30.090	30.056	30.276	30.246	30.150	29.733
14	29.863	29.856	29.990	29.966	30.083	30.146	30.206	30.230	30.183	29.840
15	29.883	29.846	30.006	30.040	29.983	30.113	30.123	30.156	30.216	30.020
16	29.936	29.833	29.926	30.026	29.950	30.053	30.05	30.116	30.203	30.163
17	29.973	29.903	29.833	29.986	29.926	30.020	30.06	30.130	30.290	30.130
18	29.950	30.003	29.753	29.956	30.013	29.943	30.236	30.103	30.176	30.130
19	29.916	30.003	29.816	29.983	30.003	30.046	30.233	30.126	29.770	30.133
20	29.926	29.993	29.820	29.946	30.086	30.083	30.17	30.226	29.690	30.130
21	29.946	29.996	29.823	29.940	30.110	30.013	30.126	30.253	29.826	30.083
22	29.993	30.010	29.956	30.010	30.016	30.056	30.106	30.210	29.880	30.100
23	29.986	29.976	29.980	30.083	29.860	30.133	30.163	30.153	29.883	30.100
24	29.976	29.933	29.933	29.970	29.840	30.150	30.12	30.080	30.010	30.090
25	29.983	29.916	29.896	29.873	30.040	30.150	30.096	30.016	30.056	30.013
26	29.973	29.943	29.953	29.923	30.006	30.103	30.14	30.053	29.993	29.896
27	29.980	29.966	30.086	29.886	30.116	30.130	30.313	29.953	29.963	29.856
28	30.043	29.960	30.026	29.820	30.150	30.056	30.276	29.910	29.843	29.940
29	29.963	29.890	29.950	29.783	30.193	29.956	30.10	29.756	......	29.986
30	29.683	29.876	29.970	29.880	30.196	30.000	29.99	29.903	......	29.906
31	......	29.983	29.920	......	30.226	......	29.833	29.966	......	29.720
Monthly means	29.946	29.926	29.949	29.944	30.003	30.075	30.157	30.072	30.054	30.006

TABLE No. 2.—*Of daily and monthly means of the Thermometer at Sacramento, Cal., from four daily observations, from June, 1854, to March, 1855, inclusive.*

Days.	1854, June.	July.	August.	September.	October.	November.	December.	1855, Jan'ry.	February.	March.
	°	°	°	°	°	°	°	°	°	°
1	58.87	69.12	64.33	66.50	74.62	51.00	57.75	49.00	53.62	58.75
2	61.75	68.75	67.87	65.00	76.00	56.75	56.50	41.50	55.12	58.25
3	65.62	74.00	72.75	61.12	76.50	57.00	52.62	43.50	56.00	58.75
4	68.12	78.50	65.87	63.75	69.00	57.62	54.00	43.50	55.25	58.00
5	59.50	78.12	65.25	65.12	65.50	59.75	51.00	34.50	55.25	56.125
6	56.25	74.62	68.62	63.00	65.50	60.50	48.75	34.25	53.75	59.75
7	62.00	78.00	70.00	63.12	65.50	55.50	46.25	40.25	56.50	61.25
8	67.00	78.50	78.50	63.50	66.50	52.75	47.00	43.50	54.87	59.00
9	74.25	77.25	74.75	62.25	62.87	56.37	44.25	44.87	56.00	57.125
10	78.25	78.00	69.75	62.25	63.50	53.62	44.87	45.00	51.75	51.50
11	71.50	77.75	76.50	60.00	64.75	55.62	44.75	44.50	50.25	51.50
12	62.87	81.12	74.25	60.25	61.25	57.62	45.37	42.50	51.75	50.875
13	67.75	86.37	72.00	61.37	57.50	54.50	46.00	41.50	54.50	53.25
14	70.87	83.87	72.00	60.75	58.00	54.37	47.50	39.75	56.50	49.375
15	68.37	78.75	77.00	60.87	60.00	55.00	47.37	38.25	58.00	46.75
16	68.87	72.00	85.00	66.25	62.25	56.87	46.25	39.50	57.00	45.50
17	62.87	69.50	84.50	72.00	61.00	57.37	49.62	39.75	54.00	49.75
18	66.25	64.75	72.75	75.25	59.00	57.00	49.12	43.37	54.37	57.25
19	71.00	65.75	71.75	78.75	58.75	58.50	46.12	46.37	48.00	58.25
20	69.87	64.25	74.62	68.50	66.50	55.75	45.75	41.75	45.25	55.75
21	64.25	67.37	73.00	67.50	65.75	55.75	45.62	42.50	45.50	58.25
22	62.50	71.75	64.00	68.50	65.00	59.87	51.87	44.62	46.87	60.75
23	66.12	78.00	69.37	71.25	61.75	60.75	51.37	45.50	47.25	64.00
24	65.25	83.00	68.12	72.50	56.25	60.75	53.50	50.75	47.00	64.125
25	66.75	76.00	64.37	68.75	58.25	60.25	54.50	53.25	51.50	63.00
26	66.50	75.75	65.50	69.37	58.00	60.87	49.25	52.00	53.87	62.00
27	69.56	76.00	62.75	71.25	56.25	59.50	44.50	51.57	54.25	57.50
28	67.75	75.50	69.00	68.62	58.50	58.50	43.25	50.75	57.00	56.25
29	67.00	75.25	64.75	66.75	58.50	51.50	42.00	51.25	.....	59.25
30	72.37	71.75	66.75	68.75	59.50	53.00	43.75	50.75	.....	57.75
31	.....	67.00	70.87	.....	57.75	.....	49.75	56.87	.....	55.50
Monthly means	66.86	75.70	70.33	65.26	62.56	56.78	48.42	44.74	52.82	56.62

Meteorological observations at Sacramento, California.

Date.	Thermometer—four daily observations.												Barometer.		
	Daily temperature.				Maximum extremes.				Minimum extremes.						
	Sunrise.	Noon.	Sunset.	10 P. M.	Sunrise.	Noon.	Sunset.	10 P. M.	Sunrise.	Noon.	Sunset.	10 P. M.	Snrise.	Noon.	10 P. M.
1854.	*														
June	54.04	76.03	72.05	65.33	66.00	87.00	84.00	78.00	46.00	67.00	62.00	50.00	29.96	29.95	29.93
July	61.25	88.74	80.17	74.88	73.00	97.50	92.00	83.00	51.50	72.00	67.00	61.00	29.90	29.95	29.92
August	55.90	81.90	76.25	67.25	69.00	96.00	95.00	84.00	49.50	72.00	68.00	58.00	29.95	29.95	29.93
September	51.38	76.33	70.63	62.70	61.00	86.00	87.00	72.00	47.00	68.00	64.00	55.00	29.93	29.97	29.92
October	51.32	71.03	68.25	59.67	62.00	88.00	86.00	75.00	46.00	62.00	60.00	52.00	30.00	30.00	30.00
November	44.21	65.25	63.13	54.53	52.00	70.00	69.00	61.00	39.50	58.00	57.00	46.00	30.09	30.06	30.07
December	37.25	55.12	53.90	47.41	52.00	66.00	54.00	57.00	28.00	50.00	50.00	36.00	30.16	30.16	30.13

* The minimum observation is used for the sunrise column.

Meteorological observations at Sacramento, California.

Date.	Attached thermometer.			Thermometrograph.*			Extremes of month.				Hygrometer, 12 M.*					
											Dew point.			Moisture.		
	Sunrise.	Noon.	10 P. M.	Mean maximum.	Mean minimum.	Mean range.	Maximum.	Date.	Minimum.	Date.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
1854.																
June	66.70	75.00	72.70	81.05	54.04	26.97	95.50	10th	46.00	2d	65.00	41.00	54.36	.802	.354	.537
July	63.00	63.00	80.87	91.32	81.25	30.22	103.00	13th	51.50	20th	68.50	43.00	60.53	.849	.243	.507
August	73.42	75.35	77.52	87.00	55.90	31.09	102.00	16th	49.50	2d	68.00	45.00	57.11	.609	.254	.460
September	68.68	70.73	73.38	81.85	51.38	29.83	94.00	19th	47.00	16th	60.50	44.00	53.31	.691	.252	.493
October	68.83	70.83	73.00	73.83	52.38	21.54	93.00	2d	46.00	14 & 27	63.00	31.00	52.19	.905	.206	.568
November	62.16	65.20	65.80	68.13	44.21	23.85	74.00	1st & 6th	39.50	10th	50.97	26.96	44.99	.686	.306	.494
December	56.03	62.58	61.54	59.04	37.25	21.79	69.00	1st & 17	28.00	30th	48.00	25.9	36.99	.813	.293	.539

* Daniel's hygrometer used until September; since then the swinging thermometer, as recommended by Professor Espy. The moisture tables were calculated from Dalton's tables of the force of vapor, while using Daniel's hygometer; and after that, from the *tension* tables of *Auguste*.

Meteorological observations at Sacramento, California.

Date.	Wind. Four daily observations. (The figures refer to the number of observations.) North to East. Sunrise.	North to East. Noon.	North to East. Sunset.	North to East. 10 P. M.	East to South. Sunrise.	East to South. Noon.	East to South. Sunset.	East to South. 10 P. M.	South to West. Sunrise.	South to West. Noon.	South to West. Sunset.	South to West. 10 P. M.	West to North. Sunrise.	West to North. Noon.	West to North. Sunset.	West to North. 10 P. M.	Sensible breeze to moderate wind. Sunrise.	Sensible breeze to moderate wind. Noon.	Sensible breeze to moderate wind. Sunset.	Sensible breeze to moderate wind. 10 P. M.	Moderate to violent wind. Sunrise.	Moderate to violent wind. Noon.	Moderate to violent wind. Sunset.	Moderate to violent wind. 10 P. M.	WEATHER. Clear, or mostly clear. Sunrise.	Clear, or mostly clear. Noon.	Clear, or mostly clear. Sunset.	Clear, or mostly clear. 10 P. M.	Cloudy, or mostly cloudy. Sunrise.	Cloudy, or mostly cloudy. Noon.	Cloudy, or mostly cloudy. Sunset.	Cloudy, or mostly cloudy. 19 P. M.	Clear all day, or mostly clear.	Cloudy all day, or mostly cloudy.	Rain. Days.	Rain. Inches.	Fog. Days.	Fog. Inches.
1854.																																				*		
June .	0	0	0	0	21	10	21	20	7	10	7	9	2	10	2	1	26	23	24	28	4	7	6	2	19	25	26	28	11	5	4	2	19	2	3	......	4	......
July . .	0	0	0	0	20	9	19	20	8	13	10	9	3	9	2	2	28	28	27	26	3	3	4	5	26	27	30	30	5	4	1	1	28	0	0	......	0	......
Aug . .	0	0	0	0	25	12	17	16	5	14	12	15	1	5	2	0	27	24	25	26	4	7	6	5	28	30	29	30	3	1	2	1	28	0	1	......	2	......
Sept . .	0	1	0	0	21	15	17	20	9	11	11	10	0	3	2	0	27	25	25	22	3	5	5	8	25	28	26	30	5	2	4	0	18	0	1	Sp'kle	2	......
Oct . . .	0	2	0	0	20	16	16	14	5	6	7	12	6	7	8	5	28	26	28	28	3	5	3	3	17	20	16	25	14	11	15	6	8	4	10	1.02	5	......
Nov . .	3	3	4	3	9	10	7	9	4	2	5	6	14	15	14	12	28	26	27	29	2	4	3	1	24	27	25	27	6	3	5	3	20	2	4	0.67	7	0.0163
Dec . . .	0	4	1	1	13	9	15	15	1	3	2	2	17	15	13	13	28	23	28	29	3	8	3	2	18	19	22	23	13	12	9	8	11	5	5	2.20	11	0.1243

* Had no rain-gauge until October.

Table of daily means of Psychrometer, with direction of wind, at Sacramento, Cal.

1854. June.	Wind. Direction.
1	SSE; S; SW; SSW.
2	SSW; SSE; S; S.
3	SE; S; S; SSW.
4	SE all day.
5	SE; S; SSE; SE.
6	SE all day.
7	SE; W; SE; SSW.
8	SSW; NW; S; SSE.
9	SSE; NW; NNW; NNW.
10	NW; WNW; SSE; SSE.
11	SE; S; SE; SE.
12	SSE all day.
13	SSW; NW; SSE; SSE.
14	S; SW; SSE; SE.
15	SE; SW; SE; SE.
16	SE; SSW; S; SSE.
17	SE; NW; SE; SW.
18	SW; NW; SE; SE.
19	SE; NW; SSE; SSE.
20	SE all day.
21	do
22	do
23	SE; SSW; SE; SE.
24	SS; SSE; SW; SW.
25	SW; NNW; SW; SW.
26	WNW; NW; S; S.
27	SSW; SW; SSW; SSE
28	SE all day.
29	do
30	SE; S; SSE; SSE.

1854. July.	Wind. Direction.*
1	S; S; SSE; SE.
2	" " " "
3	SE; WNW; SSE; SE.
4	SE; NW; SE; S.
5	SE; S; SE; SE.
6	NW all day.
7	" " "
8	NW; WNW; SE; S.
9	S; SW; SSE; S.
10	SE; S; SSW; SE.
11	SW; S; SE; SE.
12	S; N in forenoon; W; SSE; SE.
13	SE, SW; SE; SE.
14	S; NW; S; S.
15	SW; NW in forenoon; SW; SW; SE.
16	SE; S; S; S.
17	SE all day.
18	do
19	do
20	do
21	do
22	do
23	S; WNW; S; S.
24	SE; NW; SE; SE.
25	SE; SE; S; SE.
26	SE; S; S; SE.
27	SE all day.
28	do
29	do
30	SE; SSW; SSE; S.
31	SE; SE; SE; S.

1854. Aug.	Mean. D. B.	Mean. W. B.	Wind.
1	63.66	56.33	SE; SSW; SE; SE
2	70.40	61.33	SE. SW; SSE; SE.
3	74.	65.	SE; S; SE; SE.
4	67.33	58.66	SE; SSW; SE; SE.
5	65.66	59.66	SE; S; SE; S.
6	68.66	60.66	SE all day.
7	71.	65.	SE; SW; S; S.
8	78.33	64.66	do
9	75.33	62.33	S; SE; S; S.
10	69.66	61.33	SE all day.
11	71.66	63.33	do
12	75.	62.33	SE; W; S; S.
13	72.	63.	SE; S; S; S.
14	72.33	60.66	SE; SSW; SSE: SE.
15	77.	62.66	SE; S; S; S.
16	84.66	66.	S; WNW; S; S.
17	83.33	68.	SE all day.
18	73.33	61.66	do
19	71.33	61.	S; S; S; SE.
20	73.66	63.33	SE all day.
21	72.66	60.	do
22	63.66	57.33	do
23	68.66	58.	S; SSE; S; S.
24	67.66	57.66	SE; W; SE; SSE.
25	63.33	56.	S; SSE; SE; S.
26	63.66	54.66	SE; S; SE; SE.
27	61.66	54.	SE; SW; SW; SW;
28	66.33	55.38	NW; W; W; S.
29	64.33	57.66	SE all day.
30	65.66	56.66	SE; W; W; S.
31	68.66	62.33	SE; S; S; S.

1854. Sept.	Mean. D. B.	Mean. W. B.	Wind.
1	65.33	57.66	SE all day.
2	63.	56.33	S; SSW; SE; SE.
3	60.66	55.33	SE all day.
4	62.66	55.66	S; SW; S; S.
5	64.	56.33	SE; SSW; S; SSE.
6	63.	56.66	SE; S; S; SE.
7	62.66	55.66	S; S; SE; SE.
8	63.33	56.66	SE; SE; S; S.
9	62.33	55.66	SSE all day.
10	62.33	55.33	do
11	60.	54.66	S; SE; S; S.
12	59.66	54.66	S; SSE; SE; SE.
13	60.66	54.33	S; SSE; SSE; SE.
14	60.	54.	SE; S; S; S.
15	60.33	55.33	SE all day.
16	66.66	57.33	
17	71.	59.33	
18	77.	62.33	
19	67.	62.	SW; S.
20	67.66	59.33	SE all day.
21	66.	58.	do
22	67.66	59.66	do
23	67.33	59.66	SE; WNW; SW; SW.
24	69.	57.33	SW; W; S; S.
25	68.	56.66	SE all day.
26	62.33	58.66	SE; SSE; S; S;
27	70.	58.33	SE; N; NW; S.
28	66.66	58.33	SSE; SW; SE; SE.
29	66.	57.	SEE all day.
30	66.66	56.66	SE; WNW; WNW; SW.

* Psychrometrical observations not commenced before the 1st of August.

Table of daily means of Psychrometer, with direction of wind, at Sacramento, Cal.

Oct.	Mean D. B.	Mean W. B.	Wind.	Nov.	Mean D. B.	Mean W. B.	Wind.	Dec.	Mean D. B.	Mean W. B.	Wind.
1	74.	58.33	NNW; N; W; W.	1	57.	50.	NW all day.	1	57.	48.33	SW; NW; NW; NW.
2	74.33	60.66	SW; SW; W; SW.	2	55.	47.66	SE; SE; SW; SW.	2	58.33	49.	NW; NW; SE; SE.
3	75.66	61.66	SW all day.	3	52.66	49.66	SW; WNW; NNW; SE.	3	54.33	51.66	SE; SW; WSW; WSW.
4	67.66	59.33	SE all day.	4	55.66	49.33	SSE all day.	4	55.	50.66	NW all day.
5	64.66	58.	do.	5	57.66	51.33	do.	5	51.33	48.66	SE; NE; N; N.
6	65.	59.	do.	6	58.66	50.66	SE all day.	6	48.66	46.	NW; N; SE; SE.
7	64.33	57.66	S; S; WNW; WNW.	7	54.66	46.33	SE; SE; S; S.	7	46.66	44.33	W; WNW; WNW; WNW.
8	72.33	56.66	NNW; NW; SSE; S.	8	53.	48.33	SW all day.	8	47.33	42.	SSE; W; SE; SE.
9	64.	58.66	SE all day.	9	55.33	46.	SE; WNW; NW; NW.	9	42.66	40.33	SE; SE; S; S.
10	61.66	55.66	SE; SSE; SW; S.	10	51.33	47.	N all day.	10	44.66	41.33	NW all day.
11	60.33	57.33	SE all day.	11	54.33	48.66	do.	11	44.	38.66	do.
12	61.66	59.	S; S; SSW; SE.	12	56.66	48.	NW; NW; WNW; W.	12	45.	40.66	do.
13	58.	53.	SE; NE; S; S.	13	53.	48.	SW; SSE; SSE; SSE.	13	44.66	41.33	do.
14	56.33	49.66	W; N; NW; SW.	14	54.	48.33	SE; NW; WNW; WNW	14	47.	41.66	do.
15	58.	51.33	NW; NW; SW; SW.	15	54.33	46.66	W all day.	15	46.33	41.33	do.
16	59.66	53.66	SE all day.	16	55.	48.33	NW; W; W; W.	16	45.66	41.33	do.
17	60.	53.33	do.	17	56.	48.66	NW all day.	17	49.66	42.33	NW; N; SE; SE.
18	57.66	51.66	SE; S; SE; SE.	18	55.	51.	NE; SSE; NE; S.	18	51.33	43.66	W; SE; SE; SE.
19	58.	51.66	SE all day.	19	58.66	53.	NW all day.	19	46.66	40.	SE all day.
20	62.66	56.33	SE; SE; S; S.	20	54.	51.	NW; SE; SE; SE.	20	44.66	43.	do.
21	65.	58.33	SSE all day.	21	55.33	52.66	SE; SW; S; S.	21	45.66	41.	SSE all day.
22	64.33	58.33	SE; SSE; SW; SW.	22	59.66	55.66	SE; SE; SW; SW.	22	52.	45.33	SE all day.
23	59.66	54.66	SSE all day.	23	59.	53.66	SW; SE; SE; SE.	23	51.	45.33	do.
24	54.	52.33	do.	24	59.	53.	NW all day.	24	53.66	47.66	do.
25	57.	52.33	SE all day.	25	59.33	52.66	NW; N; N; N.	25	55.	51.33	SE; S; SSE; SE.
26	57.66	53.66	do.	26	60.66	53.33	NW all day.	26	48.66	44.66	SE; SW; SSE; SSE.
27	55.	50.66	SSE; NW; W; SW.	27	58.	52.	do.	27	43.33	37.33	WNW; N; NW; NW.
28	57.66	52.	SW; SE; SSE; SE.	28	57.33	51.33	do.	28	42.33	37.33	NNW all day.
29	57.33	50.	SE; NW; NW; NW.	29	51.	43.66	WNW; NW; NW; SSE.	29	37.66	35.66	NNW; NW; NW; SE.
30	60.66	50.	NW all day.	30	53.33	47.33	NW; NW; SE; SE.	30	43.33	39.	NW; W; SSE; S.
31	57.66	50.	do.					31	48.66	46.	SE all day.

Table of daily means of Psychrometer, with directions of wind, at Sacramento, Cal.

1855.	Mean D. B.	Mean W. B.	Wind.	1855.	Mean D. B.	Mean W. B.	Wind.	1855.	Mean D. B.	Mean W. B.	Wind.
Jan.				Feb.				Mar.			
1	50.	46.33	S; SW; SW; SW.	1	54.	47.66	N; S; SW; N.	1	58.66	53.66	SE; S; S; SW.
2	42.66	39.	WSW; SE; SE; SE.	2	54.33	49.	NNW; NW; NE; NE.	2	57.66	53.	SE; S; S; S.
3	43.66	41.66	SE all day.	3	55.66	48.66	WSW; NW; SW; W.	3	59.	55.33	S; SSE; NW; WNW.
4	43.66	41.33	S; SW; SW; SW.	4	56.66	50.33	W; N; SE; ENE.	4	58.33	53.	W; S; S; SE.
5	35.33	33.	SE all day.	5	54.	49.33	WNW; N; N; WSW.	5	57.33	56.	E; S; S; S.
6	34.33	31.	Do.	6	55.33	51.	N; S; SE; SE.	6	60.66	59.	S; SE; S; S.
7	39.33	35.66	NW; NW; W; W.	7	54.33	51.	SSE; S; S; SSW.	7	62.	58.66	S; SE; SE; SE.
8	44.66	40.33	NW all day.	8	55.66	52.66	S all day.	8	57.66	56.33	ESE; S; S; S.
9	45.66	43.66	NW; NW; N; SE.	9	53.66	50.33	S; WSW; WSW; NNE.	9	51.66	50.66	S; S; S; WSW.
10	45.	42.33	SE; NE; SE; SE.	10	52.	49.33	SSE all day.	10	51.66	47.	NE; WNW; W; SE.
11	45.66	43.	SE; NW; NW; NNW.	11	50.33	46.66	E; NNW; NW; NNW.	11	51.33	46.66	SE; WSW; S; E.
12	43.66	41.66	N; N; SE; E.	12	51.33	46.33	SSW; S; NNW; NNW.	12	52.33	50.66	S; S; SSE; SE.
13	40.33	38.	NW; ESE; SE; SE.	13	52.66	49.66	NW; NNW; WNW; WSW.	13	54.33	50.	S all day.
14	39.33	37.66	SE; NW; NW; SE.	14	56.	52.	SSE; S; S; NNW.	14	49.	47.	SSE all day.
15	39.	36.66	SSE; NE; SW; SE.	15	57.33	49.66	NNW all day.	15	47.	42.	NW all day.
16	39.66	37.	SE; SSE; ESE; SE.	16	57.	46.	Do.	16	44.33	36.66	NW; NW; SE; E.
17	40.33	39.	NW; N; SE; SE.	17	51.	46.33	NW; NW; NE; N.	17	50.66	44.	N; NNW; NW; NW.
18	43.33	42.	S; SE; SE; N.	18	55.66	46.33	SE; SSE; S; N.	18	58.	53.33	N; N; NW; NW.
19	47.	44.	SSE all day.	19	48.33	38.33	NNW; NNW; NW; NW.	19	59.	52.33	NW all day.
20	41.33	39.33	NW; NW; NW; W.	20	45.33	37.66	NW; NNW; NW; NNW.	20	55.33	53.33	NW; NW; NW; SW.
21	42.33	37.66	WSW; WSW; NNW; NNW	21	44.66	38.33	N; SE; SSW; SSW.	21	59.	52.33	NE; NW; NW; NNE.
22	44.66	39.	NW; NNE; NNE; NW.	22	46.66	42.	SSE; S; SSE; SE.	22	62.	57.33	NNW; NNW; NW; N.
23	47.33	43.66	SSE; SSE; ENE; E.	23	47.33	43.33	SSW; SSW; N; WNW.	23	64.66	56.66	NE; SSE; ESE; NNE.
24	51.	46.33	NW; N; NNE; SE.	24	45.66	40.33	NNW; W; N; NNE.	24	64.33	59.	NW; N; NE; NE.
25	53.	47.	SW; NE; NW; NNW.	25	52.	46.66	NNW; SSE; NW; NW.	25	64.	57.33	NE; NW; SE; SE.
26	51.66	46.33	NW; N; N; WNW.	26	55.33	52.33	SE; SE; NE; NNW.	26	61.66	54.66	E; N; N; SE.
27	50.	44.	NW; NNW; E; SE.	27	55.	53.	NW; ESE; S; S.	27	58.33	53.	S; S; SSE; S.
28	49.	43.	NW; N; NE; W.	28	57.66	56.33	SE; S; SE; SE.	28	57.66	53.33	SE; SSW; SSE; SSE.
29	51.33	46.33	NW; NNE; SSE; ENE.					29	58.33	53.33	SSE; SW; S; NE.
30	50.66	47.66	WSW; NNW; NNE; NW.					30	58.33	55.	SE; SE; SSE; S.
31	56.66	52.33	N; SE; N; NNW.					31	57.	54.	S; SSE; S; SSE.

REMARKS CONTRIBUTING TO THE PHYSICAL GEOGRAPHY OF THE NORTH AMERICAN CONTINENT.

BY JULIUS FROEBEL.

SAN FRANCISCO, *December* 8, 1854.

Since the annexation of California our geographical knowledge of the western half of our continent has made a progress the rate of which is unsurpassed in the history of geography, and almost equals the fastness of California life itself, by which it has been produced. In every direction the great wilderness of the western table-lands, and of the continental slope along the Gila and Colorado, together with the adjoining portion of Sonora, is traversed by engineers, by cattle traders, emigrants, prospecting miners, and bold adventurers, who all contribute in daily augmenting our store of topographical details concerning these vast regions. But while this store is accumulating, it cannot be expected that travellers, who have to pay attention to some particular and more or less immediate interest, should trouble themselves with geographical questions of a more general character. Thus some misconceptions in our general ideas of the physical structure of our continent, produced by some former and premature generalizations of systematic geography, are still propagated by maps and books, as well as Congressional railroad speeches, and the influence of these errors on different branches of science, as well as on common life, is important enough to make it worth while to correct them. I am referring here to the prevailing notions of the geographical system of our continent, or the manner in which its mountain chains and table lands are generally believed to be arranged and connected, or separated. As this arrangement, together with the geological constitution of the soil, form the principal conditions of the local deviations of climate and of the distribution of organic life, it is easy to conceive how the most interesting chapters of physical geography must be affected by any prevailing misconception in that respect.

A correct knowledge of the whole system of elevations and depressions of the surface of a country can only be the result of a complete and careful topographical survey and subsequent representation. To execute such a task over a large continent, like that of North America, can only be the work of generations. Even the most advanced States of Europe, small as they are in extent, and almost unlimited as the power of their governments is to expend money for such a purpose, have only lately succeeded in possessing good topographical maps of their territories. But while thus we must resign to our grandchildren the satisfaction of having a clear and correct conception of the ups and downs of the continent we inhabit, we are under the necessity, for our own present wants, to form an approximate idea. Insufficient as the number of our observations must be, and discontented as they are in a

great measure, we must try to fill up the *lacunæ* of our knowledge by generalizations and ideal connexions. It is natural that, in so doing, we should be exposed to error; but we shall keep our mistakes within the narrowest possible limits, if we proceed by the way of simple inductions, and refuse to submit to premature theories. No doubt the propensity of the human mind to bring isolated facts into an ideal connexion originates in our highest intellectual faculty, by which alone we are able to discover the general laws which govern the endless variety of cases. But there is scarcely one science which has not been led astray from time to time by this same propensity, and no science, perhaps, more so than geology, of which orography, or the knowledge of the external form of the dry surface of our globe, may, in some respects, be said to be a chapter, while physical geography in general is its descriptive department.

Among the many mistaken notions still prevalent on that subject, is the opinion that the principal systems of water-courses or the great river basins and continental depressions must be divided by mountain chains. In America this is not more true than in any other part of the world. But great and important as is the number of well known facts which prove that the less striking differences of level followed by the water-courses of a country may be independent of the system of real mountain chains, both being very often the results of two entirely different series of causes, still these facts are regarded as mere exceptions to a general rule, and, wherever positive observations are wanting, geographers continue to fill up the blanks in our maps according to that supposition. Thus, to separate the Pacific from the Atlantic slope, and especially from that towards the Mexican Gulf, the Rocky Mountains have been brought into an imaginary connexion with the Sierra Madre of Mexico, and this latter chain has been forced on our maps to take a direction which it does not take in reality. I have often heard the name of the former unhesitatingly extended to the latter by Americans living in northern Mexico, though there is an interval of several hundred miles in longitude and latitude between their nearest points. A generalization even of a bolder character is sometimes made, when the Sierra Madre and the Rocky Mountains together are said to be the continuation of the "Cordilleras" of South America. But the system of the Andes does not continue through the Isthmus of Darien; and the hills of the Isthmus of Panama have little to do with them. These hills, again, are not connected with the mountains and table lands of upper Mosquitia, of Honduras, and Guatemala, nor with the volcanic cones which rise in isolated beauty from the plains of Nicaragua and San Salvador.

It may be observed that these interruptions of continuity are not important enough to affect a general view of the subject, and it may be conceded that this is true. Certainly we may speak with all propriety of the mountains and table lands of the western side of the new world as of one great system following the course of its western coast from Terra del Fuego to the northern Polar ocean, and separated by wide tracts of flat and, comparatively speaking, low country, from the groups and chains which occupy certain sections of the eastern side of both the northern and southern continents. But this is only repeating

a fact almost too general and simple to be much dwelt upon. It being once known, as it is, to everybody, the special arrangement of the numerous subordinate members becomes the object of investigation, and it is this object we have here in view.

In this investigation the question is not only whether certain groups or chains of mountains are really connected or separated, but what other relations may exist between them, relations that may be of high interest to the geologist and meteorologist, or to those who are studying the laws of the distribution and diversity of vegetable, animal, and human life. Mountains, though separated by intervening space, may be the productions of simultaneous and connected geological processes, or, by taking corresponding situations in reference to the whole geographical structure of their respective regions, may form corresponding parts in the system of natural circumstances and conditions, so that one may be said to be the *equivalent* of the other in one or the other of the different series of causes and effects which constitute the great organism of nature. Thus we may not only ask whether the Rocky Mountains are connected with the Sierra Madre or not, but we may, if the latter be the case, put the question whether the one must not be considered, at least, as the *equivalent* of the other. This question, indeed, has been raised by the geologists of this country in respect to the different chains of our own system of mountains. It has become an interesting question of geology and physical geography, whether the peninsular chain of Lower California is the southern equivalent of the Sierra Nevada, or is that of our coast range, and whether the so-called San Bernardino chain is corresponding to any of the three, or has its own independent character and existence.

Since Elie de Beaumont has drawn the attention of geologists to certain relations which appear to exist between the bearings of mountain chains and the geological periods of their respective upheavals, it has been asserted that such questions should be decided; and that the classifications and nomenclature of geography should be regulated by the facts which constitute geological character, and not by those of mere outward form. But it is easy to show that, by subjecting the whole matter to the domination of a mere scientific principle, we yield to the claims of one science at the cost of the equally just claims of another, as well as of every-day utility. Thus, for example, it is a well established fact of geology, that different sections of the Alps are to be referred to very different geological epochs, while each of these sections has its geological equivalents in certain more or less distant parts of the world. Still it is in the interest of climatology and of the study of the distribution of plants and animals, as it is in that of common life and of human history, to adhere to the old and natural way of viewing and naming, by which the Alps are considered as one mountain chain, which has nothing to do with certain mountains or hills in Spain, in Scandinavia, and in Greece. It is an equally well established fact, that the hills in the south of England and a certain section of the Caucasus, that the Thuringian forest in Germany and certain mountains in Greece, that one section of the Pyrenees and a certain section of the Alps, are to be referred respectively to the same geological periods. Still no sensible man, unless he is considering the matter

expressly under a geological point of view, would say that these mountains respectively belong to each other. Even not to augment the sufferings of schoolmasters and schoolboys, we should abstain from innovations which would oblige them to become good geologists before they could understand, the one what he is teaching, the other what he is learning. The outward forms of the surface of our globe should be considered independently of the system of geological periods and mineral masses. The knowledge of each, though there is an intimate connexion between the two, has its own peculiar interest, and the claims of the geologist in that respect have no better foundation than those of the botanist who would propose to give different names to two sections of the same chain of mountains, because one is covered with pine trees, the other with oak.

After these preliminary remarks, intended to clear the subject of some confused notions in respect to its general principles, I may pass over to a statement of facts, which shall be mostly such as have fallen under my own observation.

1. The great chain of the Rocky Mountains divides, in the neighborhood of the origin of the Rio Grande, into two ranges, of which one runs along the eastern, the other along the western side of that river, down to about the latitude of Santa Fé.

Every one who has travelled from the Missouri river to the capital of New Mexico, is well aware of the fact that the latter part of the road, from Las Vegas to its termination, turns round the southern promontory of the *eastern range.* To the north he leaves steep, high, and mostly snow-covered mountains, while the elevations to the south are of two kinds, but both different in character from the great chain to the north. Some there are, it is true, which have been caused by plutonic eruptions, and the upheaval of metamorphic and sedimentary masses; but they are merely little isolated groups, or ridges, such as the Placer, Sandilla, and Manzana mountains. The rest are either mere declivities, or detached portions of the general table land. This latter, at an average altitude of nearly 7,000 feet above the sea, turns round that same southern promontory, from the eastern to the southwestern side of the great chain, and, running out here in a projecting corner to the westward, reaches the very borders of the valley of the Rio Grande, where, at many places, the traveller has a view over its edges down into the valley near Albuquerque. The little groups and ridges just mentioned have entirely the general character of the numerous mountains which, like the islands of an archipelago, are scattered all over the high plains of western Texas and Mexico. If, nevertheless, they be considered as the southern continuations, or representatives, of the Rocky Mountains, which in a certain sense they really are, it should be in view of the correspondence of the natural arrangement of elevations in that section of country to the western terminal range, which, south of Santa Fé, appears to pass over to the eastern side of the river, following, in this way, the general south-by-east course of the system.

2. Whoever has travelled from El Paso to California by the Gila route knows that, following Cook's route in its southern bend, he has to pass over several mountain spurs; but that, choosing the straight line of a more northern track, called Leroux's route, he passes from the Rio

Grande to the Gila, near the Pima villages, without the necessity of surmounting a single real mountain-chain. In general, there is no doubt that, if the traveller were not bound to touch the few watering places, and to avoid difficulties of another character, he could keep off from mountains altogether. If, therefore, the *western terminal range* of the Rocky Mountains should reach so far south as the origin of the Gila river, it certainly does not pass over to the south of that locality. It is, however, much more likely that the road from Albuquerque to Zuñi, and, perhaps, even the old Spanish trail from Santa Fé, by Abiquiu and the head waters of the San Juan river, to Los Angeles, turns round the real southern promontory of the western terminal range.

It is true that further south, in the neighborhood of Socorro, in about 34° of latitude, mountains of considerable elevation, and steep, Alpine forms, stand on the western side of the Rio Grande. They appear, however, to be separated from the Rocky Mountains by a wide interval of flat and open country, which has been made use of for the passage of several routes. This section of country I do not know from personal observation, except from what I could see in coming down the Rio Grande. Now, even conceding that reasons might be found to consider the mountains near Socorro as a continuation of the western terminal range of the Rocky Mountains, still they would not form a connexion with the Sierra Madre, because such a connexion cannot be found further south. Between Valverde and Santa Barbara the same group of mountains form those impassable narrows of the valley of the Rio Grande, which compel the traveller to leave the river and traverse, for ninety miles, the ill-reputed desert of the *Jornada del Muerto*, or "dead man's journey," the south-eastern portions of the group thus proving to stand on the eastern side of the Rio Grande.

3. The mountains which here obstruct the valley, those further north which rise in picturesque forms from the western side of the river near Socorro, together with the Copper Mine Mountains, and the little group of Ben Moor, appear to belong, in reality, to a central and separate system, in which the Gila river takes its origin, and which might be called the Upper Gila mountains. Its centre appears to be the *Sierra Blanca*, so called, not from being covered with eternal snow, as might be supposed, but from the white color of its rocks. In a deep and narrow cañon of the southern portion of the system I observed white masses of a porphyritic or trachytic formation, with transitions into pearlstone.

It has been pretended that the real connecting link between the Rocky Mountains and the Sierra Madre is formed by a chain called the Sierra de los Mimbres. But the traveller in the section of country where it should exist will look in vain for such a chain. The name, indeed, is only applied to the restricted and subordinate mountain locality on the southern verge of the Upper Gila Mountains, so called from the Rio de los Mimbres, a small creek which, during the dry season, is lost in the plain, but is said to continue its course so far south as to reach the Laguna de Santa Maria, a lake situated west by south of El Paso. *Mimbre* is the Mexican name of a beautiful bignoniaceous shrub (a *Chilopsis*) exclusively growing in the alluvial beds of sand and pebbles of little intermittent streams. The little creek, therefore, has its name from the shrub; and the mountain locality in which the creek

has its origin, near the now deserted Fort Webster, obtains its appellation from the creek—a fact which shows its subordinate character.

4. After having approximately defined the southern extremity of the Rocky Mountains, I have now to follow the course of those detached groups and ridges which, in a certain sense, to be explained hereafter, may be called its southern equivalent. I have already stated that, if such an equivalent exists, it is to be looked for on the *eastern* and *not* on the western side of the Rio Grande. The traveller coming from San Antonio de Bejar, on his way to El Paso or to the Presidio del Norte, has to pass these mountains, which, situated west of the Pecos river, mark a step from a lower to a higher section of the plateau of western Texas. In steep and singular forms, of a character entirely different from the hills formed by declivities and detached portions of table land, as common in western Texas as they are on the head waters of the Pecos and the Canadian, these groups and ridges of plutonic and metamorphic masses, formed by a combination of upheavals and eruptions, emerge from the high surrounding plains.

On the road to the Presidio del Norte they are passed in the *Puerto del Paisano*, on the road to El Paso, in the *Puerto de las Limpias*, or "Wild Rose" Pass, two localities of the most striking character of wild and romantic mountain scenery—particularly the latter of the two, where the walls of immense porphyritic eruptions are separated into innumerable strange shapes of needles, spires, columns, and spheroids. South of the Presidio del Norte, in the neighborhood of San Carlos, this line of mountains strikes again the Rio Grande, passing from the eastern to the western side of the river without changing its general direction, the river forming here a great eastern bend, in a long, deep, narrow, and impassable gorge, through which, in a series of rapids, it pours down from the elevated country of its upper and middle course into the deep country of the Mexican gulf. On its western side, then, the line of mountains bordering the *Bolson de Mapimi* to the east runs further south through the States of Coahuila, Nuevo Leon, San Luis Potosi, and Vera Cruz, where it forms the eastern margin of the plateau of Anahuac.

5. I come now to speak of the *Sierra Madre*. This denomination has been the cause of many geographical misunderstandings and misconstructions. It has been understood as a real proper name, while it is but an appellative, meaning the mother chain of mountains—*i. e.*, the principal chain of a country in general, just as the Mexicans call *acequia madre* the principal channel of a system of irrigation. Thus the name may occur in different localities without thereby authorizing geographers to conclude that all the mountain chains which have received that denomination belong to one and the same system. It may, therefore, really be as some maps have it—I do not know from what source—that a certain chain *east* of Durango, belonging to the line of ridges which passes over from Texas to Mexico, is known under the name of Sierra Madre, too. But it is certain, and every one who has travelled across Mexico in that latitude knows it, that the Sierra Madre, in the sense generally adopted in the country, is *not east* but *is west* of Durango, and is passed by the road from that city to Mazatlan. Of a mountain chain in New Mexico called Sierra Madre, and pretended to be situated on the west-

ern side of the Rio Grande, I have never heard. But if the name should occur there, too, as some maps likewise have it, I am almost sure that it has only been used by some Mexican theorist who wanted to convey a general idea of the geography of his country according to his own fancy—that it is not, therefore, a commonly employed term there—and under no consideration could even a fact contrary to this conviction prove any connexion of the Rocky Mountains with the Sierra Madre proper, which, following the direction of the Pacific coast of Mexico, borders the interior table-land of that country towards the low country of Michoacan, Jalisco, Sinaloa, and Sonora. If such a conclusion could be allowed to be drawn from a mere name, it would certainly be as justifiable to prove a connexion, or at least a relation, of the Sierra Madre proper to that chain of mountains which our geologists now call the *San Bernardino chain*, but which the old Californians likewise know under the name of Sierra Madre.

Now as to the Sierra Madre proper, there is a singularity in the natural structure of this marginal chain, which, though by no means uncommon in other similar chains in different parts of the world, is one of the principal causes of the misconstructions of our maps in respect to western and northern Mexico. Nearly all the more considerable rivers which empty into the Gulf of California have their origin on the high plains of the interior table-land—that is to say, on the eastern side of the Sierra Madre—and, bursting through deep and narrow gorges or rents, cross the chain at right angles before they come down on a lower terrace of the country, and ultimately into the "*tierra caliente*" of the coast. This fact is to be seen in the most striking manner on the road from Chihuahua to the rich mining place of Batoseágachic, where the traveller passes, without any ascent, from the high plateau on the eastern side of the Sierra down into the deep country on its western side, through one of these openings; the road coming out on the latter side at an elevation of several thousand feet above the lower country, where he may see the orange and banana, while he is still in the region of the pine-trees and of a northern climate. The water-course at the bottom of the transversal gorge is tributary to the Rio del Fuerte, which empties into the gulf somewhat south of the Rio Yaqui. One of the two principal branches of this latter river, the Rio de Papigóchic or Conception, shows a similar phenomenon. For nearly a hundred miles it runs along the eastern side of the sierra in a northerly direction, through the beautiful savannas of the western table-land of Chihuahua, passing many fine little towns, until at last it makes a sudden turn to the west, enters a gap in the mountains so narrow that it is scarcely perceptible in the landscape, and through it dashes down into the deep country on the western side of the chain. One of these two passages must be had in view by the projectors of the railroad from El Paso or the Presidio del Norte to Guaymas, for which Santa Anna has lately given a concession. As geographers, however, have not understood this character of the chain, they have placed it so far to the east of its real situation as to get it on the eastern side of the origin of the rivers of Sonora and Sinaloa.

At the same time there are some reasons to suspect that the astronomical positions of the interior of these two States are likewise too far

east; by which circumstance, if my supposition, suggested chiefly by the comparison of distances on both sides of the mountain chain, should prove just, the sierra, even keeping its relative situation, would be brought nearer to the line of direction of the Rocky Mountains than it comes in reality, and by the combinations of the two errors the disfigurations of our maps appear to have been doubled. Thus, while the southern terminal ranges of the Rocky Mountains have been laid down too far west, the northern terminal ranges of the Sierra Madre have been laid down too far east, and both have been brought nearer to each other than they really are.

6. Of the latter ranges, the extreme northern spurs, situated south of the middle and lower Gila, are passed by Cook's route on the trail between the Guadalupe pass and Fort Yuma. Near the latter place, or the junction of the Gila and Colorado, the Coast Range of Sonora and Sinaloa, which forms the western foot of the whole Sierra Madre system—a system which, throughout its whole extension, is formed by parallel ranges—has its northern termination. Beyond the Gila and Colorado, however, its direction is continued by a chain of mountains which the traveller on his way through the desert, between the latter river and Carizo creek, has at some distance to his right hand. At a very acute angle it converges with the chain which comes from the peninsula of Lower California, till at last it falls in with it, the San Bernardino peak forming, as I have been assured by persons who have been on the spot, the point of junction. Thus the extreme northwestern spur of the Sierra Madre constitutes what has been called by geologists the San Bernardino range, but has been known to the old Californians under that same name of Sierra Madre, as I have already stated. If, therefore, the Sierra Madre has a northern equivalent, we have to look for it not in the Rocky Mountains but in the Sierra Nevada system. But the real meaning of all these relations will receive more light from their connexion with the more general structure of the western half of our continent, of which, therefore, I shall try to give a few outlines.

This western half is known to be composed of a great longitudinal basin, extending, in a direction corresponding to the Pacific coast, from the Isthmus of Tehuantepec to the polar region. Through the greater part of its extent it is confined between an eastern and western marginal chain of mountains. The greater part of its surface has an elevation which gives it the character of a table land, and by its marginal chains it is separated from an eastern and a western lateral terrace.

In California and Oregon, Utah and New Mexico, and in the countries farther to the north, the two marginal chains are clearly and conspicuously marked by nature. The eastern one is formed by the Rocky Mountains, the western one by the Sierra Nevada, Cascade Mountains, and their more northern equivalents. In Mexico, the western chain is constituted by the Sierra Nevada, and is likewise clearly traced by nature; but the eastern one, composed of that line of detached and irregular groups and ridges which crosses the Rio Grande from east to west at the narrows and rapids of San Carlos, is less conspicuous, and may be entirely overlooked by those who are not sufficiently informed about the matter. Nevertheless, as already stated, if the Rocky Mountains have a southern equivalent, it must be recognised in the mountains of western Texas, Coahuila, Nuevo Leon, San Luis Potosi, and Vera

Cruz; and if the Sierra Madre has a northern equivalent, it must be recognised in the Sierra Nevada, the Cascade Mountains, and their more northern continuations: because the first line forms the eastern, the second line the western borders of the great longitudinal basin of our western interior, the whole construction being thus under the rule of a strict physico-geographical analogy.

8. Though in respect to its prevailing elevation, this great basin may be called a plateau or table-land, still it has considerable differences of altitude, and three great slopes—not to speak of similar phenomena of a minor importance—which form transitions from the inner and higher to the outer and lower countries: that of the Rio Grande, that of the Colorado and Gila, and that of the Columbia—the former breaking through the western marginal chain.

Between the middle part of the valley of the Rio Grande and the middle part of the valley of the Gila, the country is less elevated than to the north and south of that line. The level of *Lake Guzman*, situated west-southwest of El Paso, is, according to Mr. Schuchart, even lower than that of the Rio Grande at El Paso. *Lake Santa Maria* must have about the same level. Into this latter lake the *Rio Mimbres*, which comes from the north, is said to empty in time of copious rains; while from the south the *Rio de Santa Maria*, emptying into the same lake, rushes down from the central plains of Chihuahua. A line traced from these two lakes to the *Dry Lagoon* of Cook's route, forms a north-western continuation of this depression of the table-land; and from the latter place the middle part of the Gila may be reached without over-coming any considerable elevation, which, however, would be found to exist to the north as well as to the south of that line. The upper Gila runs in a narrow part of the higher country north of it; and though its bottom may be even lower than the level of the open country along the general line of depression, still that does not form an objection against the general construction, as it has neither an opening to the Rio Grande nor is it accessible much higher up than where the road from Tucson first strikes it. If Cook's wagon route, in taking from *Dry Lagoon* a southwestern course to the Guadalupe pass, deviates to the south of our line, it is because it follows a series of fine watering and pasture-places, situated just between the mountains of the highest section of country, which contains the origin of the southern affluents of the Gila and of the northern river of Sonora.

9. Thus it would appear that an ocean of a level not much higher than the Rio Grande near El Paso would separate Mexico from the rest of North America.

But an ocean of that level—setting aside the more important changes it would produce in the form of our continent—would cover the Colorado desert, and, extending over the deep mountain passes southeast of Los Angeles, would gain the Pacific here, and make an island of Lower California.

It is very possible that such a state of things has really once existed. The nearly horizontal strata of the cretaceous formation of Texas appear to enter in a western direction and unconformable superposition between elevations of other sedimentary rocks and granite, syenitic, porphyritic, and trachytic mountains, which must have already existed when, and must have been above the surface of the ocean in which

the cretaceous strata were deposited. Strata of that formation, in unconformable superposition, appear to exist at several places between upheaved and eruptive tracts of country, in northern Chihuahua and Sonora. And if a closer geological investigation should really prove that, a little south of the upper and coinciding with the lower Gila, a branch of the ocean should once have formed a strait across what is now forming our present continent, we might say that some hundred thousand years ago the natural line of a railroad, which in our days should connect the eastern and western side of that continent, was already traced by nature.

It is an interesting fact that the desert north of the Lower Colorado, which is in the western continuation of that old range of lower country, is, even now, perhaps, the lowest spot of the American continent—as, according to recent measurements, it is in part even somewhat under the level of the ocean. While travelling through that country, I was struck by certain phenomena connected with the periodical filling and drying of what has been called *New River*, and of the several lagoons connected with it. The immense mud deposits of *Little Lagoon*, which I have examined, prove the former existence of long and uninterrupted periods in which the water of the Colorado entered the desert and kept the bed of New River, together with the basins of this lagoon, full; while the existence of mezquit trees, now killed by its water, from which the upper parts of their trunks and branches emerge in a dead state, proves that other uninterrupted periods have passed when the water of the Colorado did not enter the desert. Now, it has been asserted that these fluctuations are the consequence of the more copious or more scanty rains in the countries drained by the Colorado and its tributaries; but the fluctuations appear to have been of such an extent in time and level, that the cause assigned to them appears to me to be inadequate to the effect, and I am more inclined to believe that the phenomenon is, at least in part, produced by fluctuations of the ground in consequence of the action of subterranean forces. There is a large solfatara even now in action at the northern side of the Lower Colorado.

10. But to return to my strictly geographical object: It follows from the foregoing statements and remarks that the great longitudinal basin which constitutes the inner part of the western section of our continent, is divided, by a depression of soil which runs from the Middle Rio Grande to the Middle Gila, into a northern and a southern table-land, the former being that of New Mexico, Utah, Upper Oregon, and other more northern countries—the latter that of Mexico in its present confines, as they have been fixed by the Gadsden purchase. At the same time it can be seen how great an error it is, affecting the whole physical geography of the continent, to bring the Sierra Madre into connexion with the Rocky mountains. It makes the western marginal chain of the southern to be the continuation of the eastern marginal chain of the northern half of the great longitudinal basin, separating analogous and confounding heterogenous phenomena of orography, of climatology, and of the distribution of vegetable and animal life. Those who have studied the climate, and the flora and fauna of these regions, will find that I am right in my assertions.

MISCELLANEOUS CORRESPONDENCE

ON

NATURAL HISTORY.

Some Remarks on the Natural History of Beaver Islands, Michigan.

BY JAMES J. STRANG.

SAINT JAMES, BEAVER ISLAND, *December* 7, 1853.

Secretary of Smithsonian Institution:

I have prepared for your use the following lists of animals, plants, &c., found upon the "Beaver Islands," in Lake Michigan, which I beg to submit to you. I am aware that these lists are quite imperfect, but hope they will serve some useful purpose until better can be prepared.

Truly and sincerely, yours,

JAMES J. STRANG.

DOMESTIC ANIMALS.

Horses, oxen, sheep, swine, dogs, cats.

WILD ANIMALS.

Foxes, red, quite numerous.

Foxes, black, scarce; silver grey, very rare. Some hunters assert that these are the same variety, the colour only distinguishing the sex. The silver grey is the most valuable fur in market, a single skin being priced at more than fifty dollars.

Hare, or rabbit. Two species, large and small.

Chipmunk, or red ground-squirrel.

Otter, very scarce.

The beaver are extinct. Caribou, or reindeer, range as far south as here, but visit the islands only on the ice, and very rarely. Elk are found on the east shore, and bears on both. American deer are found as near as Green Bay and Manistee river, *piloting civilization.*

BIRDS.

Geese, brant, duck (numerous varieties), loons, gulls (two varieties), crows, hawks, (several varieties), woodcock, pigeons, blackbird, robin, redheaded woodpecker, snipe, snowbird, pewee.

FISHES.

In some of the small streams on the mainland "brook trout" are found in abundance. Most of the streams are destitute of them, but abound in other fish, the names of which I do not know.

The small lakes within the islands, as well as the mainland, are well stocked with fish, of which perch, suckers, and bass, are the most abundant.

In lake Michigan, among and around the islands, are sturgeon, pike, pickerel, siskowit, trout, whitefish, herring, suckers, perch, ling or lawyers.

STURGEON, (*Aupenser.*)—I have been able to learn very little of the habits of the sturgeon. While the shoal channels among the islands are frozen, the tribe of Indians residing on Garden Island depend much upon them for subsistence. They are usually taken with spears, in from one to four fathoms water.

The quality of the flesh is very fine. Properly cooked, it can scarcely be distinguished from veal cutlet. They also make from them considerable quantities of lamp-oil, quite superior to that furnished by contractors for the light-houses.

The mode of taking them is as follows: The fishermen go onto the ice at the favorite resorts of the sturgeon, and cut holes through the ice about one foot in diameter. By the side of the hole they put down a small quantity of hemlock or cedar brush, (either of which is an antidote to frost.)

On the brush the fisherman lies down, with his head over the hole, covering himself entirely with his blanket, so as to keep out all light, except what reflects up from the water. He is provided with a spear of great strength, usually consisting of but one tine, with three or four barbs on *one* side. The spear-handle is thirty or forty feet long, and of heavy wood, so that it will penetrate the water with a slight effort. The spear is not made fast to the handle, but slightly pressed into a mitre in the end of it; so that the first motion of the fish will take the spear out of the handle. But the spear is connected to the handle by a strong cord several fathoms in length. The reason for this is, that the struggles of the fish would break a very strong spear handle if the spear was fastened. But, by this arrangement, the fish spends his strength in pulling upon the cord, without being able to get loose.

It is supposed the fish congregate around the holes in the ice to breathe the fresh air. The fisherman watches their coming, and seizing the first favorable opportunity, seldom fails of taking one if within twenty or thirty feet. The sturgeon are exceedingly shy. They are not sought in the summer, and very seldom taken in seeking other fish.

I have never learned the weight of sturgeon in this region. They are usually from four to seven feet long—and are of value simply as winter subsistence for the Indians.

Pike and Pickerel.—I can communicate nothing reliable concerning pike and pickerel. They are taken in small quantities for market; but none of the fishermen have been able to give me any information as to their habits. It is even disputed among fishermen whether they are not one and the same variety of fish, though, I think, without any good reason.

SISKOWIT, (*Salmo siskowit.*)—Siskowit abound principally in Lake Superior, where the best quality are taken. But they are taken in limited quantities in Lake Michigan. Fishermen generally suppose they are a mule between trout and white-fish, and their appearance

favors this opinion. But they are very abundant in parts of Lake Superior where the quantity of white-fish and trout is not large, and in various parts of Lakes Huron and Michigan. Where white-fish and trout are always found together, no siskowit are found; which is hardly consistent with the theory that they are produced by a crossing of the two. Five minutes' intelligent observation at the spawning season would dispel the doubt, but I can find no person who has made it.

The siskowit is the fattest of all fish, and yet has no unpleasant or oily odor. It is valued in market above all the fish of the lakes. But there is a species of white-meated trout, of indifferent quality, so greatly resembling siskowit that it is frequently sold under that name, by which means the siskowit is undervalued, except where well known.

MACKINAC TROUT (*Salmo amethystus*).—The trout of this region have a world-wide fame, under the name of Mackinac trout. There is no good reason for the use of this local name, as they are found from Dunkirk, on Lake Erie, to Fond du Lac, on Lake Superior, and Milwaukee, on Lake Michigan, and I presume through a much wider region. What relation they bear to the trout of other regions I am unable to determine.

The trout are great eaters, and subsist principally on other fish. They are always pursuing white-fish and herring, and are not unfrequently caught in the nets while stealing white-fish from them.

Indians take them in the winter with spears, in the same manner as the sturgeon; also, in the same manner, with snatch-hooks instead of spears, using an artificial decoy fish, but no bait.

Trout are taken for market by trolling, with snatch-hooks, set hooks, gill-nets, and seines.

The apparatus for snatching trout can hardly be described as "a stick and a string, with a worm at one end and a fool at the other." A trout hook is made of steel wire, from one fourth to three eighths of an inch in diameter, is weighted with about two pounds of lead, in the shape of two cones with the bases joined, through which the shank passes lengthwise. The line is a cotton one of the strength of a bed cord, usually from three to six hundred feet in length. In fishing through the ice, the moment a bite is felt the fisherman throws the line over his shoulder, and runs with all his might, in a direct line, till the fish is on the ice. When in a boat, he allows the fish to run with the hook, occasionally pulling lightly, till the captive's strength is exhausted, and then pulls him in. As high as eighteen barrels have been snatched in one week by two persons; but four barrels a week is very good fishing.

Of trolling and set-hooking I could add nothing to what is generally known, except that the apparatus corresponds in strength with that used in snatching. Seining and gill-netting will be described under the head of whitefish.

I think the average weight of trout caught in seines and gill-nets (after dressing) is not above four pounds. Those caught with hooks are a trifle heavier. But individuals weighing fifteen pounds are common, and they have been taken of above fifty pounds weight.

Their spawning season is in autumn, about the first of November; but

individuals are found with mature spawn several months earlier. I have thought it possible that they spawn more than once a year.

WHITEFISH (*Coregonus*).—The whitefish are the most abundant, and, as an article of commerce, the most valuable fish of this region. Fifty thousand barrels per annum are taken among the Beaver Islands, and the quantity is rapidly increasing. As an article of food they are preferred to the trout, and inferior only to siskowit. Indians occasionally take them through the ice with spears. But they are only caught in quantities with seines and gill-nets.

Seines of all sizes are used in the usual manner. The seining begins soon after the disappearance of the ice in the spring, and lasts from one to three weeks, when various kinds of fish are taken, suckers being most abundant, but whitefish are taken in large quantities. The spawning season makes about three weeks of whitefish seining in November.

Fishing is principally done with gill-nets. The season begins from the middle of May to the forepart of June, according to the warmth of the weather, and usually ends the first week in December.

Gill-nets are usually about five or six feet wide, and twenty rods long. If designed for trout the meshes are four inches, for whitefish three and a half, and for herring three inches. When set for fishing, one edge is weighted with stones and the other buoyed up with cedar floats, so that they maintain a vertical position. From six to twelve nets are bridled together and called a gang.

When the nets are prepared for setting, the fisherman takes them to some favorite resort of the fish, usually a feeding or spawning place, and first sinks a stone anchor to the bottom and makes fast to it a buoy with a flag-staff and flag attached; then fastening the end of the gang to a buoy by a line long enough to reach the bottom, he rows or sails his boat in the direction he wishes to place the nets, paying out the nets as the boat moves till he gets to the end, when he fastens to it another buoy and flag by a line long enough to drop the net to the bottom.

The nets are usually left in the water three days, when they are lifted, the fish taken out, stones and floats taken off, and the nets dried, repaired, and prepared for setting again. Twenty fish to a net is a good yield, but as many as one hundred are sometimes taken.

Whitefish come into the shoals in the spring (for what purpose I have been unable to learn); hence the spring seining. The first gilling is usually in from two to five fathoms water. As the season advances they retire to deeper water, till by the first of September they are found in from fifty to one hundred and fifty fathoms water. Indeed, off Fox Island nets have been set with success in water fourteen hundred feet deep. The largest fish come from the deep water.

The spawning season begins in November, and terminates in December. This year (1853) it commenced November 11, and is apparently just closing (December 7). The spawning season is indicated by the fish leaving deep water and appearing in immense numbers on rocky shoals. The first day they appear upon the shoals the nets take all males, apparently well stocked with milt. The second day a few females appear among them, plump with spawn. The proportion of

females increases till after a week or ten days, when they are two, three, and four times as many as the males, after which the females slowly disappear, and the males last leave the spawning ground.

The best opinion seems to be that the males precede the females only to prepare the ground, especially as they at that time assume an extraordinary roughness of the scales, and employ themselves constantly in scraping up gravel on which the spawn is subsequently deposited. Some, however, believe that the mere inclination to milt causes them to seek the proper positions without reference to the presence or absence of females. Others still are of opinion that they preceed only to wait for the females, and do not commence milting till the spawning commences. The males have been accused of lingering on the spawing ground to feast on the spawn; but this is contrary to nature, and, undoubtedly, a slander. The most careful observers assure me they are employed in *covering up the spawn.*

Seining during the spawning season is the most productive of all fishing. Twenty barrels with a seine one hundred rods long is a common haul. One hundred and forty-seven barrels have been taken at a single haul. But there are very few places adapted to it. The only situation adapted to it is a smooth sand or shingle beach, a bottom free from rocks and surrounded by rocky reefs.

HERRING (*Coregonus*).—Herring are taken in the same manner as whitefish; also in gill nets, set under the ice in winter. They are usually the first taken in the spring. I have not been able to learn their spawning season; and their habits have been very little observed. When heavy winds prevail, they seek shelter in quiet bays, and in the lee of the various islands. Flocks of gulls hover over them continually, and carnivorous fish pursue them wherever they go, even into the nets. They are killed by a very slight touch. Indeed, they seem to be the prey of everything that eats fish.

The average weight of dressed herring is not above one pound. They are usually pickled in the same manner as whitefish, and not unfrequently sold under that name, but are too small to be desirable. When scalded and smoked, after the Scotch mode, they are equal to any ever found in market, and are remarkable for fatness. Labor is too dear to justify saving them in this manner.

I have never compared them anatomically with salt-water herring, and therefore do not know whether these are genuine herring. But from flavor and general appearance, I presume they are. [They are entirely different.—S. F. B.]

Herring, whitefish, and trout, are found of several varieties, differing materially in their qualities, and something in their appearance and habits. But we have no names for the several varieties, and their peculiarities have not been noted.

SUCKERS (*Catastomus*).—The lake suckers, though similar to the fish of the same name in most of the western rivers, are very superior in quality for eating. For this reason, and to avoid the ill repute of the name "*sucker*," they are usually sold under the name of "lake shad," a name founded merely on caprice, and used for purposes of fraud. They are not supposed to bear any resemblance to the shad.

Suckers are usually taken with seines, early in the spring, at the

mouths of rivers and brooks. They frequent particular shores and shoals in June, but whether for spawning or some other purpose, I have been unable to learn; they are there taken with seines in great quantities. Suckers are sometimes taken for manure alone.

Perch.—Perch abound in all the waters of this region, except mere brooks, and are in constant use fresh, but are never preserved in any way. I find no man who has observed their habits in any respect. They are taken with hooks and spears with so much facility, that children hook them with pins, and spear them with sharpened rods.

Bass.—Bass, of two or three varieties, are found in one of the lakes within this island; I presume they abound in others. No notice has been taken of their habits, and I can get no information concerning them from those who fish for them every year. They are taken both winter and summer.

Ling or Lawyers (*Lota*).—These are a valueless fish, taken in small numbers. They will live twenty-four hours out of water. No amount of boiling will make the flesh tender. If exposed it will not rot, but only dries up like an oxhide. The Indians eat the livers only.

Sunfish (*Pomotis*).—Sunfish abound in all the small lakes. Nothing is noted of them. I cannot get even an intelligent description of them, though they are frequently caught for food.

General remarks.—Trout subsist on all kinds of fish. They are a voracious fish of prey, seizing and devouring, so far as we can learn, every other kind, even their own. Herring are their constant prey. Whitefish of two pounds weight have been found within the belly of the trout. Small trout are sometimes found in them. Whitefish in gill-nets are gnawed and torn by them, and in this operation the largest trout are frequently themselves tangled in the meshes of the nets and taken. It is supposed they seek the spawn of other kinds of fish, and that the whitefish seek rocky shores to avoid them; and in support of this theory it is alleged, among other things, that when the whitefish are spawning nets set a little further out catch trout. Possibly, however, this may arise from the habit of the trout of spawning in a little deeper water.

Whitefish subsist on a kind of worm of the same structure as the leech. Probably it may be a leech, but white and semi-translucent for want of red blood to prey upon. Also upon the seed of a kind of seaweed, or submarine moss, which exists in great abundance in all the deep waters of this region. On inquiry of a dozen intelligent fishermen I can hear of but one instance of a whitefish being found with fish in his belly.

Throughout the fishing region there are vast submarine meadows, rising almost to the dignity of forests. Probably most of the fish subsist on this growth, and a few only by prey. If this is the case, the supply of fish will ever be regulated by the productiveness of these fish-meadows; for so numerous are the spawn, that no conceivable amount of catching can sensibly diminish the stock of fish. The usual spawn of a female is between fifty and one hundred thousand.

Whitefish are only found in very pure water. In channels of the greatest depth, where steamboats are constantly passing and occasionally throwing over ashes and litter, the whitefish disappear.

Where fishing is extensively carried on, many nets are lost by the lines parting, and the buoys and flags going loose. The nets remain at the bottom continually catching fish, which remain and perish. Other nets, with fish in them, are broken up by storms and left scattered about the bottom. The effect of this is to drive off the fish and destroy the fisheries. But no amount of fishing, where these calamities were avoided, has ever sensibly diminished their productiveness.

SPAWNING GROUNDS.—In passing over the lake in the fishing region, when the surface is perfectly unruffled, the man of science is surprised to see the bottom *regularly paved with large stones*. Careful observation shows that, naturally, the bottom was strewn with boulders, varying in weight from such as can be lifted with one hand to mountain masses of detached rock.

Selecting some convenient point with a large boulder as a nucleus, the others *have been rolled together*, so as to form a compact pavement, in some instances, of many acres in extent without a single blank space. In doing this work all the other ground is cleared of rock, except here and there a boulder of several tons weight. Throughout these pavements a few large boulders remain scattered as by the hand of nature. But, except them, the smallest rocks are in the centre of each pavement, gradually enlarging as you approach the circumference, till the outside courses are only perceptibly less than the scattered boulders which remain unmoved. There is an entire absence of all mathematical arrangement, but in its kind no work of man can be more perfect.

The islands of this region are an upheaval, and in several places these pavements are now above water and can be examined to advantage, and there can be no mistake as to their structure. They are found in the greatest depths that the eye can penetrate. Some are a few rods and others many acres in extent; and the vacant spots intervening are (except occasionally an immense boulder) as thoroughly cleared of every kind of stone as a well-kept lawn. They present only the appearance of clean washed sand.

Fish, when spawning, are observed to place small stones and pebbles in this same order, and all are agreed that these are spawning grounds. When it is considered that the ponderability of stone in water diminishes as the depth increases, it may not be deemed incredible that the present known species of fish have made these pavements for spawning grounds. I will not, however, speculate further, but submit the fact for the consideration of those more capable of judging.

A thousand avocations and duties constantly pressing upon me have prevented my giving the attention to these subjects that I would be pleased to. But if the few facts I have been able to obtain, and this hurried communication, prepared in haste (with many others) in the few hours that the last steamboat of the season lies in this harbor, is of any value, I shall be quite happy to continue to correspond, and to continue, as far as possible, to make observations for that purpose.

THE [illegible]

On the habits of the Black [illegible]

BY JOHN [illegible]

"On my return from a [illegible]
of Sand creek, Jackson County, [illegible]
vember 26; and, in order [illegible]
therein expressed. I will give [illegible]
species of fish, (which I consider [illegible]
quality as a pan-fish and [illegible]
the bass, (called by the [illegible]
or black perch). They are [illegible]
a large and hard mouth [illegible]
three quarters of a pound [illegible]
caught to weigh as high as [illegible]
when small, appears to be [illegible]
when larger, though not [illegible]
principal food is the smaller [illegible]
they retire to deep and still water [illegible]
logs, &c., and remain there [illegible]
and begin to ascend the streams [illegible]
for spawning, which commences [illegible]
little according to the warm[illegible]
about taking place, they [illegible]
and hunt out some [illegible]
eighteen inches deep [illegible]
can escape if alarmed [illegible]
that is, washing all the [illegible]
fectly clean, in a circular [illegible]
about twice the length [illegible]
positing her eggs [illegible]
stones, in rows [illegible]
and day, either on [illegible]
guarding the eggs [illegible]
watching or guarding [illegible]
hatched, which [illegible]
perature of the water [illegible]
and appear like [illegible]
ually rise and [illegible]
one shifts for [illegible]

I, as yet, [illegible]
for a young [illegible]
from the [illegible]
find large [illegible]
length, rather [illegible]
and fall of [illegible]
ting together [illegible]
in length; [illegible]
about eight [illegible]
them, [illegible]

[illegible] d
[illegible] y
[illegible] ne
[illegible] l,
[illegible] *lo-*
[illegible] *cu-*
[illegible] nk,
[illegible] *is.)*
[illegible] *us-*
[illegible] this
[illegible] und
[illegible] iate
[illegible] (*C.*
[illegible] and
[illegible] y or
[illegible] *roli-*
[illegible] *Bison*
[illegible] In
[illegible] white
[illegible] *inter*
[illegible] ared
[illegible] ians,
[illegible] inter,

[illegible] golden
[illegible] *virgin-*
[illegible] black-
[illegible] *lus versi-*
[illegible] (*C. cris-*
[illegible] *a caroli-*
[illegible] sh, (*Turdus*
[illegible]) blue bird,
[illegible].) wood-peck-
[illegible] g-fisher, (*Alcedo*
[illegible] ght-hawk, (*Capri-*
[illegible] *orra*,) "pheasant,"
[illegible] *ido*,) *golden plover,
[illegible] ane, (*Grus canadensis*,)

[illegible] ng in this vicinity, differs some-
[illegible] iptions of *T. cupido*. It is possibly
[illegible] fore coming to this station, and pos-
[illegible] r bird when specimens were procura-

other, and the victor devours his antagonist. I cannot, therefore, send you a pair at once, as I promised; and this is the first and only one I have seen this summer, except one killed and mangled in taking, so thoroughly did my boys wage their war of extermination on them last year. I will watch for more in the spring, if wanted. I have not time now for a more particular description, but will answer in future any questions desired. You are aware of its mischievous destruction of hedges and fruit-trees, as also of clover and all root crops.

On the habits of a species of Salamander, (Amblystoma opacum.) Bd.

BY THE REV. CHARLES MANN.

GLOUCESTER C. H., *Virginia.*

One of my sons requests me to say that, in all the cases in which he had found the Salamander with *eggs*, the latter were under the animals, both male and female being curled up over them. From the number found in this way, there can be little doubt of the eggs having been laid by the animals. This was the case with the specimen sent. The first specimen obtained a year ago with eggs, which he could find no means of sending you, and the one sent, *were* found in November. He says, he has seen them in the summer with eggs. The localities are the beds of *small ponds* in the woods, which in rainy seasons have water in them, but were dry when he obtained these. I sent a younger son, the other day, to get other specimens; and he returned saying he found but one pair, and they ran into the water (the late rains having partially filled the pond). These had hatched, and had several young. The nests of the one sent, and of others previously taken, were in a small hollow in the surface of the earth, deeply covered with leaves, and under which were tunnels extending in various directions. In these hollows the animals were, as I have said, curled up over their eggs. My son has been too much otherwise engaged to look for other specimens as yet, but will search for more and send them on if he succeeds in getting them. The specimens I mentioned in my letter were more interesting, because the eggs contained the embryos, as I supposed, near the period of hatching. Not knowing how to keep them, I put them in a box of sand; the old ones escaped, and the eggs dried up. The other varieties were found in a spring branch. We are fully assured they are oviparous; the old opinion of the young taking refuge in the stomach of the mother, may or may not be true. Of the common lizard, we have more than once found the eggs with perfectly formed animals in them, on one occasion so formed, that the young one ran away on the covering of the egg being cut.

My sons request me to send you some more Salamanders. A large one with one hundred and eight eggs under it was found in December. The young animals were so far matured that they were in motion as soon as released from the covering. The largest specimen was found near a pond, say twenty or thirty feet from it, and tunnels,

like those of mole hills, extended from the nest in every direction under the leaves, as if the animals had been in search of food. No *small ones* have been *found out of the water*, except the very small ones which we send you, and these have come from the broken eggs.

On the Amblystoma luridum, a Salamander inhabiting Wisconsin.

BY P. R. HOY, M. D., OF RACINE, WISCONSIN.

Characteristics: Back bluish-black, with light amber spots; tail compressed, larger than the body; length 11 inches.

Description: Body robust, smooth, and shiny; head large; snout rounded; eye moderately prominent; neck short, with a distinct cervical fold; nostril small, sub-lateral; mouth opening beyond the eyes; tail sub-quadrangular at its origin, then becomes compressed laterally, moderately arched, and terminated in an obtuse point, rounded on the upper and under edges, with a notch above just below the vent. A vertebral furrow at the termination of the body and origin of the tail. Legs stout, anterior four toed, the posterior five toed, and two fifths larger.

Color: Above, back, tail, head, and extremities bluish-black, with reddish reflection, and spotted with pale amber; mouth and circle round the eye reddish lemon; flanks with a row of large oblong orange spots slightly varied with lemon yellow. Below, abdomen slate-blue, spotted irregularly with pale lemon and orange; tail, inside of legs and feet, thickly punctate with black, toes all tipped with the same; throat and chin orange, irregularly sprinkled with crimson points.

Length	11.00
Head and body to centre of vent	5.25
Tail	5.75
Head, length to gular fold	1.20
" breadth between the eyes	0.72
" just back of the eyes	1.00
" breadth between the nostrils	0.40
Tail, breadth at vent	0.80
" " one inch below	0.95
" " at the vent	0.35
Hind-leg, including longest toe	1.75
Fore-leg, " " "	1.30
Longest toe of hind-foot	0.43
Longest toe of fore-foot	0.26

Their motion on land is slow, but they swim with activity. They resent any insult offered to their mouth or eyes by quick and repeated strokes with their ample tails. I have met with but two individuals of this fine reptile, which were found about my cellar after a wet night.—(The first October 20, 1849, and the last November 1, 1850.) They are nocturnal, and, probably, only quit the water in the fall in order to seek some *congenial* winter quarters.

DIARY

Of an excursion to the ruins of Abó, Quarra, and Gran Quivira, in New Mexico, under the command of

MAJOR JAMES HENRY CARLETON, U. S. A.

WEDNESDAY, *December* 14, 1853.

A squadron of cavalry, formed of company "H," first dragoons, commanded by First Lieutenant Samuel D. Sturgis, and company "K," first dragoons, commanded by Brevet Major James Henry Carleton, in all one hundred strong, with one 12-pounder mountain howitzer, left Albuquerque, at eleven o'clock this morning, as an expedition to explore the country around the ruins of Gran Quivira, New Mexico, and for other objects connected with the bands of Apache Indians who often infest that portion of the territory.

Our route, for the first forty miles, lies down the left bank of the Rio Grande. This part of the country has often been described. Its principal features are easily named. The Rio Grande, at this point, averages about one hundred yards in width, and not more than eighteen inches in depth. Its waters are turbid, like those of the Kanzas. Its bottom and banks are composed of sand. The valley along the river is very level, and usually not over two feet higher than the surface of the water. In some places it is more than two miles broad. It has a great deal of sand mixed with the soil; but it is remarkably fertile. From this valley a second bottom, or table-land, extends, by a gradual ascent, back to the mountains on either hand. This table-land is destitute of water and uncommonly sterile. The lower level, which skirts the river, and which is irrigated from it, is the source of nearly all the agricultural wealth of New Mexico.

A storm of rain which came on yesterday continued, almost without intermission, for the whole of last night and until late this forenoon; the roads are, therefore, very muddy. In consequence of the heaviness of the travelling, the squadron was encamped near the residence of an American gentleman, named Baird, seven miles 694 yards below Albuquerque. Here we are able to obtain wood and hay; but we are obliged to send across the Rio Grande to purchase corn.

THURSDAY, *December* 15, 1853.

About four o'clock this morning it commenced snowing, with a piercing wind from the north. Our poor horses, exposed to the inclemency of the storm, were soon chilled and trembling with the cold. By eight o'clock the weather began to moderate; but we had snow-

squalls, from different points of the compass, for the whole forenoon. Before we reached a little hamlet, called Valencia, fourteen miles 265 yards from our camp of yesterday, we encountered a shower of rain and sleet. As in this place we could get two *corrals*, wherein our horses could be partially sheltered, it was decided that we should encamp here for the night. The weather seems singularly unpropitious for an expedition. It is said to be quite unusual to have these storms in New Mexico at this season of the year. To-night, however, at nine o'clock, the clouds have all left the heavens, and we have promise of a fair day to-morrow.

Three Mexican citizens of respectability, a Mr. Chavis and two of his sons-in-law, came to our camp this evening, and informed Major Carleton that it was their intention to establish a colony of settlers at a point east of a range of mountains known as the Sierra Blanca, and along some streams affluent to the Pecos, called *the Seven Rivers;* that they proposed going with this command as far as Gran Quivira; and that from that point to the Seven Rivers they desired to be furnished with an escort of dragoons. They were told that they could accompany the expedition as far as Gran Quivira, but that no escort would be given beyond that point. They were informed that Brevet Lieutenant Colonel Chandler, of the army, was about to proceed from near Doña Ana, with three companies, directly to the country in the neighborhood of the Seven Rivers, and, if they wished to do so, they could have the advantage of his protection. Mr. Chavis concluded to go by the way of Gran Quivira, at all hazards; and to proceed across the country, from that point, even without an escort. The truth doubtless is, the old gentleman fancies that the purpose for which this squadron is going into that country is to search for a great amount of treasures which are said to be buried beneath the ruins there, and he hopes he may be able to obtain a share of them.

FRIDAY, *December* 16, 1853.

The weather became very cold last night; all the ponds of water extending up and down the valley are frozen over, and the ground is hard and resounds loudly at the tread of the column. The sand-bars along the river seem to be covered with geese, ducks, and brant, which have been driven by the ice from the lagoons and sloughs. They are so tame they hardly fly at our approach.

We arrived at a little town, called Casa Colorada, about four o'clock this afternoon. This place is thirty-nine miles 537 yards from Albuquerque. Here our road leaves the river for the mountains toward the east. As it will take two days to march to Manzana, the next and last point where we can procure any corn, we are encamped for the night; and shall here buy, and haul in our wagons to-morrow, the forage our animals will require to that town.

The citizens of Casa Colorada gave a ball this evening in honor of our coming. The sudden arrival amongst them of so many armed men is a matter of great astonishment.

The result of our observations, as regards the general appearance of the inhabitants of the country, made during these first forty miles of

our march, may be stated in a few words. The dirty little villages through which we have passed, as well as those we have seen in the distance, have generally turned out their inhabitants *en masse* to get a sight at us. This gave us a sight at them. Had we been painters it would doubtless have been an interesting one; for men, women, children—motley assemblages—exhibited themselves to us in groupes picturesque, as well as in crowds grotesque. Some blanketed, with sombreros and cigarritos; some with whitewashed and some with scarlet-dyed faces, some with rebosos, some nearly naked, some on housetops shading their eyes with their hand, and some peering through chinks and crannies in the mud walls of their dwellings; but all curious as to whence we came and whither we were going. The national expression of *Quien sabe* appeared deeply written on every face. In no rancho or village have we seen a solitary indication of industry, cleanliness, or thrift since we left Albuquerque; and it may be remarked, parenthetically, that we have yet to see, in that town, the first evidence of these cardinal virtues. Indolence, squalid poverty, filth, and utter ignorance of everything beyond their corn-fields and acequias, seem to particularly characterize the inhabitants who are settled along the east bank of the river. We have seen nothing denoting energy on the part of any one, save that shown by the old man Chavis and his two sons-in-law. On the contrary, we could but observe amongst them what seemed to be a universal proclivity for rags, dirt, and filthiness, in all things; with sheer laziness and listlessness marking their every movement and all that they do. It may be said that the people whom we saw were of the lower order; but we were justified in coming to that conclusion from not seeing any of a better class.

SATURDAY, *December* 17, 1853.

We started this morning at eight o'clock. For about two miles our road lay up a gradually inclined plane, where we found ourselves on an almost level *mesa* that stretched, uninterruptedly, eastward to the base of those mountains which commence at the Sandia Peak and extend towards the south below El Paso del Norte.

This plain is sandy and entirely destitute of water. We saw several herds of cattle grazing upon it; but, so far as we could observe, there was very scanty pasture. Our guide, a Mexican, informed us that these herds are driven to the Rio Grande for water only once in two days. We saw but a solitary flock of antelopes, numbering some ten or twelve. This was midway between the river and the mountains.

The scenery, viewed from elevated points on this plain, was very beautiful. The Socorro and the Ciboletta ranges of mountains, and the distant peaks of others toward the north, were covered with snow, and gleamed in the sun with dazzling splendor. The long Sierras towards which we were now moving were also clothed in a winter-robe of white. They bounded the whole eastern horizon. Their tall summits and jagged outline, like a fringed edge, standing sharp and cl arly defined against the morning sky, glowed in the light as if burnished with silver. While towards us, along their whole western slope—which

descended toward the plain as a coast towards the ocean—the valleys and precipices reposed in cold blue shadows, chilly enough to make the beholder shudder in looking upon them.

Just before arriving at the foot of these mountains, we found a pond of water four hundred yards to the right of the road. Our guide informed us that in the dry season no water can be obtained at this place.

There are here two passes through the mountains; the one on the left hand going eastward, leading through a difficult *cañon*, is practicable only as a bridle path; the one on the right hand affords every natural facility for making a most excellent road for wagons.

These passes are known, in the language of the country, as *Los Puertos de Abó.* The summit of the right hand pass is nineteen miles and sixty-three yards from Casa Colorada, and lies east 20° south from that town. The road for this whole distance is by far the finest we had seen in New Mexico, and is not surpassed, in any point of excellence, by the celebrated shell road at New Orleans.

The first outcropping of stone which we observed as we approached the mountains was of quartz, trap, and greenstone. These are surmounted by numerous strata of fossiliferous limestone, of good quality. These strata in some places are hundreds of feet in thickness. This latter formation prevails exclusively at the summit of the pass.

There is no timber of any kind to be met with until you come near the top of the mountains; the growth then is entirely of dwarfish piñon and stunted cedar.

We encountered snow half way up the pass. The scene presented by the column winding its circuitous route to the summit, with parts of it lost to view behind some jutting crag, or just emerging into sight from some deep gorge—the foreground filled with the dragoons moving upon different turns of the road, the sun glancing brightly on their appointments—the towering snow-clad peaks on either hand—the back ground the valley of the Rio Grande, with the distant mountains in the northwest marking with a serrated line the far off horizon—was a picture whose beauty will not easily be forgotten.

The general direction of the chain of mountains stretching northward of the pass toward Sandia Peak is north 10° west. The first elevated peaks southward of Sandia are called *La Tetilla;* the next *La Sierra de la Manzana;* then come *Los Puertos de Abó;* and then the high range still further south which is known as *La Sierra del Palo Duro.*

From the summit of the pass for the first two or three miles the road is very circuitous. It then has an easy gradual descent for about three miles further, when you come to a deep cañon which lies entirely to the left, but in sight of the road, and at a distance from it of six or eight hundred yards. There, in the cañon, good sweet water is always found. This place is called *Agua de Juan Lujan.* Near this, but a few hundred yards further east, we passed a large spring of salt water. It is known by the Mexicans who travel the road as *La Salada.* Passing this, we next encountered, for some three or four miles, *mesas* of dark chocolate-colored sandstone, through which we wound our way to a point where the roads forked. We took that which leads to the left hand. In less than half a mile, our road lying up the dry bed of a wet-

weather creek, we came to a fine streamlet of fresh water. This was fringed by a beautiful grove of cotton wood. At the distance of four hundred yards, after we struck the water, we came to the RUINS OF ABÓ. Here we are encamped for the night.

At this time, when so many surveys are making from different points along the Mississippi toward the Pacific, with a view of ascertaining the best route for a railroad track, perhaps the suggestion may be of value that the Pass of Abó offers advantages in this respect which may not be found in any of the other passes through these mountains. They are certainly of sufficient consideration to make it an object to have this pass thoroughly explored before others shall be adopted. By directing the route from Anton Chico, on the Pecos river, immediately past the Ruins of Abó, and thence through the cañon by which the bridle-path lies that has already been spoken of, the open plain in the great valley of the Rio Grande can be reached without tunnelling a rod, and with no more difficulty as to the blasting of rocks and grading down of acclivities, than has been encountered on any of the ordinary railroads in the United States. Let the road be directed across the plain so as to pass the Rio Grande at the mouth of the Puerco river, thence up the valley of that river to its west branch, and up the valley of that branch to Laguna; thence to Zuñi, and from that point by the route which the indefatigable Whipple will without a doubt find, to the shores of the Pacific. These suggestions may possibly be of practical utility to those who are engaged in by far the greatest enterprise of modern times.

The RUINS OF ABÓ consist of a large church, and the vestiges of many other buildings, which are now but little else than long heaps of stones, with here and there portions of walls projecting above the surrounding rubbish. There is yet standing enough of the church to give one a knowledge of the form and magnitude of the building when in its prime. The ground plan of this structure is in the form of a cross, its longitudinal direction being within ten degrees of the magnetic meridian. It was, perhaps, situated exactly upon that meridian when the building was erected—the variation of the compass accounting for the present difference. The great entrance was in the southern end. From thence to the head of the cross, where the altar was doubtless situated, it is one hundred and thirty-two feet, inside. This, the nave of the church, is thirty-two feet in width. The short arm of the cross, or what in cathedrals is called the transept, is forty-one feet in length and twenty-three in breadth. The transept is sixty-six feet from the doorway. These measurements were made with a tape-line in a very high wind. The round numbers in feet are, therefore, only given, without noting the fractional parts of a foot.

The walls are of great thickness, and their height is, at this day, in over half the structure, all of fifty feet. The upper edge of these walls is cut into battlements. The church, as well as the neighboring buildings now in ruins about it, was built of a stratified, dark red sandstone, such as crops out along the creek and makes its appearance on the sides of the surrounding hills. The pieces of stone do not average over two and a half inches in thickness, and are not generally over one foot in length. Each piece is of the form it had when it was broken

from its native bed. We saw not a single dressed stone about the ruins. These stones are laid in mortar made of the ordinary soil from the ground immediately at hand. The roof of the church was evidently supported by beams and covered with earth, as in the churches still occupied as places of worship throughout New Mexico. We saw no signs of an arch, nor any indication that those who planned and built the church at Abó were at all acquainted with architecture as a science. The walls over the doors and windows, so far as we could observe, had been supported by beams of wood. When these had become destroyed, those stones which were liberated above had dropped down; so that now, over each window there is a rude sort of Gothic arch, owing its form, not to design, but to accident. The wood-work of the church was evidently destroyed by being burnt. Wherever in the walls portions of beams still remain they are found charred and blackened by fire.

The form of the church alone, proves it to have been designed by Christians. Perhaps the workmen employed in its construction were Indians. We saw a distinct mark of an axe in one of the pieces of timber, which is imbedded in the east wall of the church some six feet from the ground. Saws also were doubtless used, but we discovered no marks of them. The stick of timber marked with the axe, and some beams that supported a landing at the head of the stairway which is made in the west wall, were the only pieces of wood about the ruins which were not burned so much over their surface as to obliterate all marks of tools.

The extent of an exterior wall, which, from the appearance of the present heaps of stones, once surrounded the church and the town, was about nine hundred and forty-two feet north and south, with an average width east and west, of say four hundred and fifty feet. A large population must have occupied this town and its neighborhood, if one were to judge of the number of people by the size of the church built to accommodate them at their devotions.

We saw few, if any, unmistakeable signs that the ground had been cultivated in the vicinity of these ruins. Nor is there any good arable land, so far as we could observe, at any point nearer the Rio Grande; for uplands to be arable, in the climate of New Mexico, must be so situated as to be capable of irrigation. The stream of water at Abó is in a deep ravine. It is very inconsiderable in point of size, and loses itself in the sand in less than five hundred yards below the springs which feed it. The adjacent country is rolling and broken, and covered with piñon and cedar. The underlying rocks are secondary red sandstone. The summits of the mesas and neighboring eminences are composed of grey limestone filled with marine fossils.

It was nearly night when we reached Abó. There was a keen freezing gale from the northwest, and the whole appearance of the country was cheerless, wintry, and desolate. The tall ruins, standing there in solitude, had an aspect of sadness and gloom. They did not seem to be the remains of an edifice dedicated to peaceful, religious purposes, a place for prayer, but rather as a monument of crime, and ruthlessness, and violence. The cold wind when at its height appeared to roar and howl through the roofless pile like an angry demon. But

when at times it died away, a low sigh seemed to breathe along the crumbling battlements; and then it was that the noise of the distant brook rose upon the ear like a wail.

In the mystery that envelopes everything connected with these ruins—as to when, and why, and by whom, they were erected; and how, and when, and why, abandoned—there is much food for very interesting speculation. Until that mystery is penetrated so that all these questions can be answered without leaving a doubt, Abó belongs to the region of romance and fancy; and it will be for the poet and the painter to restore to its original beauty this venerable temple, to rebuild its altars, and to exhibit again unto us its robed priests, its burning censers, its kneeling worshippers.

SUNDAY, *December* 18, 1853.

It took us until half past nine o'clock this morning to complete our examination of the ruins. We then marched over a rolling and, in places, broken country twelve miles 760 yards, and in a general direction of N. 12° E. For the whole of this distance the country is covered with groves of cedar and piñon trees. We then came to the *Ruins of Quarrá.* These appear to be similar to those of Abó, whether regarded with a view to their evident antiquity, the skill exhibited in their construction, their preservation at the present time, or the material of which they are built. They too are situated upon a small stream of water that soon disappears in the earth.

The church at Quarrá is not so long by thirty feet as that at Abó. We found one room here, probably one of the cloisters attached to the church, which was in a good state of preservation. The beams that supported the roof were blackened by age. They were square and smooth, and supported under each end by shorter pieces of wood carved into regularly curved lines and scrolls, like similar supports which we had seen at the ends of beams in houses of the better class in Old Mexico. The earth upon the roof was sustained by small straight poles, well finished and laid in herring bone fashion upon these beams. In this room there is also a fire-place precisely like those found in the Mexican houses at the present day.

We had heard that in a stone panel inserted in the front end of the church at Quarrá we should find emblazoned the *fleur-de-lis*, the ancient armorial bearings of France; and many therefore supposed that possibly this church had been erected by French Catholics who had come as missionaries across the country from the direction of New Orleans. But we saw no panel, no fleur-de-lis, and no stone of any kind, that bore marks of a chisel or of a hammer. Every piece in the church, in the cloisters, and in the debris of a neighboring village, was in the same rough form which it had when it was broken from the quarry.

The course from Quarrá to the town of Manzana is, W. 35° N.; the distance is four miles 1,145 yards. We now find ourselves at a very great elevation. The whole country is clad in a winter garb. The high Sierra de las Manzanas, and the towering pyramidal peaks called Las Tetillas, gleam with a depth, it is said, of more than two feet of snow.

The town of Manzana is situated at the base of the Sierra of that

name, and a small rivulet which, in running eastward to the open plains, soon sinks into the ground. Several dams are constructed along this rivulet, to collect and retain the water for purposes of irrigation. The town is built partly of logs set on end *jacal* fashion, with the interstices filled with mortar, and with roofs covered with earth, and partly of *adobes*. It sports a very dilapidated church, erected, it would seem, as a practical antithesis to the morals of the inhabitants; for Manzana enjoys pre-eminently the wide-spread notoriety of being the resort of more murderers, robbers, common thieves, scoundrels, and vile abandoned women than can be found in any other town of the same size in New Mexico, which is saying a good deal about Manzana. Fortunately it contains but few inhabitants, not more than five or six hundred at most. It is not an old town. When the first settlers came here they found two groves of apple-trees, one just above the site now occupied by the town, and one just below. Tradition says these trees were planted at the time Abó and Quarrá were inhabited; and yet, tradition has lost all trace of when that time was. It is said the Catholic church of New Mexico claims that they were planted by some priests, but admits that it has no records or authentic traditions about the ruins we have visited. Her claim, however, that *some* priests did this at *some* period or other, is good enough to authorize her to farm out these two orchards yearly, as we were informed, to the highest bidder. Two of the largest trees in the lower grove were found to be respectively eight feet and six feet in circumference. The largest was hollow —a mere shell of an inch or two in thickness. These trees have a venerable appearance. They have never been pruned, and have, therefore, grown gnarled and scraggy. Many of them are much smaller than those which were measured. They have grown, doubtless, from seeds which have fallen from the older ones. How long this process of self-planting has been kept up, of course, no one can know. Apple-trees are not indigenous to New Mexico. Assuming it to be true, however, that the largest of these trees were planted at the period referred to, then the ruins of Abó and Quarrá are more than two centuries old.

These two groves, or rather these two clumps of trees, are not standing regularly in rows and orchard-like; on the contrary, they are crowded together in the most irregular and natural manner.

The name of this town, and of the towering Sierra to the west of it, was adopted from finding these orchards here; *Manzana* being the Spanish for apple, and *Manzano* the botanical name in that language for apple-tree. The name of the town is spelt indiscriminately in both ways throughout New Mexico.

Immediately about Manzana, and up the slope towards the high mountains west of the town, there is a pine forest many miles in extent, of most excellent timber for boards and for building purposes. Some twenty-five or thirty miles in an easterly direction there is a large salt lake, which has no outlet. This lake, supplies nearly the whole of the upper portion of the territory with salt. There are fine roads leading towards it from different directions. We were informed that the bottom of the lake is covered with a sheet of solid salt, which, in the dry season, is some three or four inches in thickness. When the rainy season sets in, filling the lake with fresh water drained from the sur-

rounding prairies, this sheet of salt is said to dissolve down to half this thickness. We were not prepared to examine and visit this lake. It lies directly off our route, and has neither wood nor fresh water within many miles of it. The proper time to go to it would be during the rainy season and when there is grass.

We had procured orders from the vicar general of New Mexico for what corn we should require at Manzana—corn which had been paid in by the peasantry as tithes *(diezmos)* to the Catholic church. When we arrived there, we found that the corn belonging to the church was some six or eight miles off, at another village, called Torreon. So we were forced to buy on credit what forage we required.

Here we learned that a small party of Texans had recently been at the ruins of Gran Quivira in search of treasures. Whilst there they sent an Apache Indian in to Manzana for some articles they wanted. An American named Fry, a hunter, who lives at Manzana, went out to the ruins in company with two Mexicans to see these Texans; when he reached there he found them gone. He ascertained while he was gone that there was no water to be found at a pond where our Mexican guide expected we should find it, as it had dried up; and that unless we found another small pond some six or eight miles from that, and which our guide knew nothing about, we should be obliged to go without any, for he said there was probably no snow about the ruins, as about Manzana, which we could melt. So Fry was employed to pilot us to this pond, as, failing to find it, we could obtain no water nearer to Gran Quivira than at the little stream at Quarrá, which is a distance of thirty-five miles.

MONDAY, *December* 19, 1853.

This morning we loaded the wagons with all the corn they would hold; but it did not amount to over two days' feed, as our other supplies had to be taken along besides. In addition to this the dragoons put into their haversacks enough for their horses for one night. We started about ten o'clock in the morning and retraced our steps toward Abó, to a point on the road known as *arroyo de la Cienega*—a dry bed of a wet-weather stream. This is nearly two miles below Quarrá. Here we left the beaten track and took a course across the country in the direction of E. 40° S. After travelling some six miles we struck an Indian trail which leads from Manzana to the country of the Mescalero Apaches. This we followed in the same general direction to some holes in the rocky bed of another wet-weather stream called *Las Aguachas*. These often contain water enough for a small party with animals, but we found them quite dry. One, only, had a small cake of ice, but no water. They are 13 miles 1,022 yards from where we left the road. The country for this distance is quite barren. It has but little grass, but is covered with the tall branching cactus, and with scattered clumps of piñon and cedar-trees. On our right hand, for the last third of this distance, we have had a mesa covered with timber to its summit, which is called *La Mesa de los Tumanes*. It is improperly laid down upon the maps as a Sierra, or mountain range. It runs from west to east, commencing a few miles south of Abó and ending in a point on the plains about fifteen miles east of Las Aguachas, where we

cross over it by ascending gradually through an open prairie, which can easily be seen from the place where we left the road below Quarrá.

The stone that crops out at Las Aguachas is a remarkably fine sandstone, suitable for grindstones and whetstones. The best is at the upper end of the ravine where the last pool of water would be found in the wet season.

When we reached this point it was nearly night. A cold piercing wind was blowing, and it was yet some miles to the place where we hoped to find water. The wagons were some two or three miles behind; Major Carleton pushed on with the squadron, having Fry for a guide, to find the pond before dark; leaving Lieutenant Sturgis with twelve men at Las Aguachas, to wait for the wagons, and then follow with them on the trail. The Mexican guide stayed with the lieutenant, that he might track the squadron after night should set in. After travelling a little over five miles, the squadron arrived at the water. It was found in a deep hollow in the open prairie. The pond is not over eighty or one hundred yards in diameter, and might easily be missed after dark even by one acquainted with its locality. The water is fresh and sweet. This pond is nearly a mile from timber. It lies immediately off against the mouth of a pass through the Mesa de los Tumanes, and is known to the shepherds as *La Laguna de la Puerta*, the Lake of the Pass. Here we made holes in the ice, and, having watered all the horses, moved up into the pass, where we found wood in abundance, and very good protection from the cold wind. We soon had large fires burning, which served as a beacon to the lieutenant, who was behind bringing up the wagons. Shortly after dark he arrived. One of the wagons was immediately unloaded and sent with the water-kegs to the lake; the men taking lanterns to see to get the water through the ice. By ten o'clock at night our horses were groomed and fed, the men had had their suppers, and large piles of piñon wood were blazing the whole length of the camp, giving it a cheerful and picturesque appearance.

This camp is twenty-five miles and 90 yards from Manzana.

TUESDAY, *December* 20, 1853.

As we knew it would be quite impossible to march to Gran Quivira and make the necessary observations there and back to the laguna in one day, it was decided to rest this forenoon, and to fill the kegs and India rubber water-tanks with water, and then to march to the ruins in the afternoon; to encamp near them to-night; to employ the forenoon of to-morrow in their examination; and then to return to-morrow evening to this place. In this way our animals would not be without wate more than a day and a half. We accordingly broke up our camp about half-past twelve o'clock. After we had filled our kegs and tanks at the laguna, we ascended a high ridge for a mile or more, when our guide pointed out to us what he said was the great church or cathedral, at Gran Quivira. It was in an air line all of thirteen miles distant, and yet we could see it distinctly with the naked eye. We could have seen it easily when five or six miles further off, had there been no obstruction to the view; a proof of the remarkable clearness of the atmosphere in this elevated region. It lies S. 5° E by the com-

pass from Laguna de la Puerta, and served for a land-mark towards which to direct our march. Our course was a very straight one; for the country, which is an open rolling prairie, offered no impediment to our moving in a right line. The weather changed to be very cold during the afternoon; when near sunset a fierce wind arose from the direction of the snow-clad mountains in the west, and a cold vapor like a cloud came over the country, enveloping everything in a dense fog, and covering men and horses with a hoar frost. It was feared that the gale would change into one of those dreadful winter northers which are sometimes experienced in this country, and which are so fatal to men and animals when exposed to their fury on the open prairie. So the direction of the march was changed, that we might get the shelter of the timber on the slope of the Mesa de los Tumanes, which stretched along our right at a distance of not more than three or four miles. This we struck very opportunely, just as night was setting in. We soon had large fires blazing, and all our horses well blanketed and picketed on the leeward side of them, to get the benefit of the heated air and of the eddy in the wind from the long line of tents. In this way they were kept from suffering, although the night was uncommonly cold and inclement.

So still another day has passed away, and the ruins are not yet reached. Quivira would seem always to have been a difficult place to arrive at. We find in Castañeda's history of the expedition into this country made by Francisco Vasques de Coronado, in 1540, '41, and '42, that that general was forty-eight days in hunting for it, starting from some point between the Rio Grande and the Gila river. All the way from Albuquerque we have asked the people of the country where the ruins were situated? How they looked? Who built them? &c., &c. To all these questions we could seldom get a more definite reply than *Quien sabe?* It seemed as if the genii who, in the Eastern tale at least, are said to guard the depositories of great treasures, were determined to make the existence of such a place as Gran Quivira as much of a problem to us as to the Mexicans themselves. We had seen, before the fog set in, an edifice in the distance, which had seemed to move away as we approached it, like the weird lakes of water in a mirage. But to-morrow, at all events, will decide for us whether that edifice be a Fata Morgana or not.

WEDNESDAY, *December* 21, 1853.

At daybreak this morning every tree and spire of grass, and even the blankets upon our horses, were covered with ice. The trees seemed as if every twig was made of frosted silver. The wind had gone down, and overhead the sky was clear; but a heavy bank of fog extended all along the east, obstructing our view of the Sierra de las Gallinas, which bounds the horizon in that direction. It was long ere the approaching sun waded up through so dense a veil.

Soon after we left camp we again saw the cathedral of Gran Quivira; but in surmounting one eminence after another as we moved along over a rolling country, the ruins, phantom like, seemed to recede before us the same as yesterday. When we first saw them this morning they appeared to be about a mile and a half distant, when

in reality they were more than five miles off. The last three of these five miles' travel was over nothing but a succession of sand hills covered with a tall coarse grass, with two or three heads on each stalk, which seemed to be peculiar to this place. The horses sank more than fetlock-deep into the soft yielding sand; while it was with great difficulty that the mules, at a snail's pace, drew the wagons along.

At eleven o'clock in the forenoon we came to the last high ridge on the point of which the ruins are situated. This ridge is composed of dark blue compact limestone, which crops out in several places along its slopes. The ascent is quite abrupt on every hand, except towards the east; the ridge is prolonged in that direction for several miles. We all felt rejoiced that finally we had reached a place about which so much had been written, and yet so little had really been known.

Whatever may have been the grandeur and magnificence of that place in ages long past, its present appearance and condition are easily described.

We found the ruins of Gran Quivira to consist of the remains of a large church, or cathedral, with a monastery attached to it; a smaller church or chapel; and the ruins of a town extending nine hundred feet in a direction east and west, and three hundred feet north and south. All these buildings had been constructed of the dark blue limestone which is found in the vicinity.

The cathedral, which we had seen from Laguna de la Puerta, is one hundred and forty feet long outside, with the walls nearly six feet in thickness. It stands longitudinally W. 15° S., with the great entrance in the eastern end. The altar was in the western end. Like the churches at Abó and Quarrá, it is constructed in the form of a cross. From the doorway at the foot of the cross to the transept, it is eighty-four feet seven inches; across the transept it is twenty-one feet six inches; and from thence to the head of the cross it is twenty-two feet seven inches; making the total length, inside, one hundred and twenty-eight feet eight inches. The width of the nave is twenty-seven feet; the length, inside of the short arm of the cross, is thirty-six feet. A gallery extended along the body of the cathedral for the first twenty-four feet. Some of the beams which sustained it, and the remains of two of the pillars that stood along under the end of it which was nearest to the altar, are still here; the beams in a tolerably good state of preservation—the pillars very much decayed; they are of pine wood, and are very elaborately carved. There is also what, perhaps, might be termed an entablature supporting each side of the gallery, and deeply embedded in the main wall of the church; this is twenty-four feet long by, say, eighteen inches or two feet in width; it is carved very beautifully, indeed, and exhibits not only great skill in the use of various kinds of tools, but exquisite taste on the part of the workmen in the construction of the figures. These beams and entablatures would be an ornament to any edifice even at the present day. We have cut one of the beams into three parts, to take back with us. The entablatures are so deeply set in the walls that we are unable to procure a piece of them. The beams are square, and are carved on three sides; the floor of the gallery rested on the fourth side.

The stone of which the cathedral was built was not hewn, nor even

[illegible]

[illegible] of head.

[illegible] the ground in the vicinity has ever been culti-
[illegible] of irrigating ditches. Indeed, an [illegible]

or open aqueduct, could not, it is believed, have brought water to the Gran Quivira, for the point occupied by the town appears to be considerably higher than the surrounding country.

We were informed by men at Manzana who had been *pastores* in their youth, and had herded sheep in this region of country, that there is a fine bold spring of water at the base of the Sierra de las Gallinas, about fifteen miles from the ruins, and that they had heard that water once ran in an aqueduct from that spring to the Gran Quivira. This could hardly have been possible, unless the aqueduct was a closed pipe; because, from appearances, the country intervening between those two points is considerably lower than either of them.

We saw no indications that there had ever been such an aqueduct, nor did we see any sign that wells had been digged in the neighborhood. From every feature of the country, both within and without the surrounding sand-hills, we could but be lost in conjecture as to the method adopted by the inhabitants to obtain even water to drink, let alone for purposes of irrigation, unless they were supplied by some spring or stream that has long since disappeared. The nearest point where water can always be obtained *now*, is the spring which the *pastores* spoke of as being at the base of the Sierra de las Gallinas, fifteen miles away. The Laguna de la Puerta is 14 miles 773 yards from Gran Quivira, in nearly a direct line; but this is said to become entirely dry in seasons of great drought.

As at Abó and Quarrá, we were surprised at not finding, in the cathedral and chapel, some of the doorways and windows surmounted by an arch. Had they been so, originally, these buildings would be in a better state of preservation. The beams across windows and doors, in giving way to the weight above as they became decayed, made a fair beginning towards letting down the whole superstructure.

Mr. Gregg, in speaking of the ancient ruins of New Mexico, says: "The most remarkable of these are *La Gran Quivira*. This appears to have been a considerable city, larger and richer by far than the capital of New Mexico has ever been. Many walls, particularly those of churches, still stand erect amid the desolation that surrounds them, as if their sacredness had been a shield against which time dealt his blows in vain. The style of architecture is altogether superior to any thing at present to be found in New Mexico. What is more extraordinary still is, that there is no water within less than some ten miles of the ruins; yet we find several stone cisterns, and remains of aqueducts, eight or ten miles in length, leading from the neighboring mountains, from whence water was no doubt conveyed. And as there seem to be no indications whatever of the inhabitants having ever been engaged in agricultural pursuits, what could have induced the rearing of a city in such an arid woodless plain as this, except the proximity of some valuable mine, it is difficult to imagine. From the peculiar character of the place, and the remains of cisterns still existing, the object of pursuit, in this case, would seem to have been a *placer*—a name applied to mines of gold-dust intermingled with the earth. Other mines have, no doubt, been worked in the adjacent mountains, as many spacious pits are found, such as are usually dug in pursuit of ores of silver; and it is stated that in several places heaps of scoriæ are found.

"By some persons these ruins have been supposed to be the remains of an ancient pueblo, or aboriginal city. This is not probable; for, though the relics of aboriginal temples might possibly be mistaken for those of Catholic churches, yet it is not presumed that the Spanish coat of arms would be found sculptured and painted upon their façades, as is the case in more than one instance. The most rational accounts represent this to have been a wealthy Spanish city, before the general massacre of 1680, in which calamity the inhabitants perished,—all except one, as the story goes,—and that their immense treasures were buried in the ruins. Some credulous adventurers have lately visited the spot in search of these long-lost coffers, but as yet (1845) none have been found."

There is no indication that the escutcheon of Spain was ever sculptured or painted on any façade about the ruins; and the facts, as regards the style of architecture and the remains of an aqueduct, do not, as is shown by this journal, agree with his statement. Mr. Gregg must have described the appearance of this place from what he heard about it; for on all those subjects of which he wrote from personal observation he is most excellent authority.

Pedro de Castañeda accompanied Francisco Vasquez de Coronada in his great expedition to the north in search of gold. He wrote a history of the campaign. General Vasquez de Coronada arrived in a country which was called *Quivira*, in the month of June, 1542. *If* the present ruins of Gran Quivira are in a region identical with the Quivira then visited, it may be of interest to state what Castañeda says of it and of its inhabitants:

"Up to that point the whole country is only one plain; at Quivira, mountains begin to be perceived. From what was seen, it appears to be a well peopled country. The plants and fruits greatly resemble those of Spain: plums, grapes, nuts, mulberries, rye, grass, oats, pennyroyal, origanum, and flax, which the natives do not cultivate, because they do not understand the use of it. Their manners and customs are the same as those of the Teyas; and the villages resemble those of New Spain. The houses are round, and have no walls; the stories are like lofts; the roofs are of straw. The inhabitants sleep under the roofs; and there they keep what they possess."

The manners and customs of the Teyas, to which he likens those of the people of Quivira, are described as follows:

"These natives are called Querechos and Teyas. They live under tents of buffalo skins tanned, and subsist by the chase of these animals. These nomadic Indians are braver than those of the villages; they are taller, and more inured to war. They have great troops of dogs, which carry their baggage; they secure it on the backs of these animals by means of a girth and a little pack-saddle. When the load becomes deranged, the dogs begin to bark to warn their master to adjust it. These Indians live on raw meat, and drink blood; but they do not eat human flesh. Far from being evil, they are very gentle, and very faithful in their friendships. They can make themselves very well understood by signs. They cut meat in very thin slices, and dry it in the sun; they reduce it afterwards to a powder, to preserve it. A single handful thrown into a pot answers for a meal, for it swells greatly.

They prepare it with the fat which they preserve when they kill a buffalo. They carry around the neck a great intestine filled with blood, which they drink when thirsty. If they open a buffalo, they squeeze the masticated grass which is found in the stomach, and drink the juice which runs out; they say that this is the whole substance of the belly. They open a buffalo at the back, and divide it at the joints, by means of a piece of pebble attached to the end of a stick, with as much facility as if they used a knife of the best steel."

The present ruins are not the remains of the round houses with roofs of straw, which Castañeda describes as the dwellings of the inhabitants of Quivira, three hundred and twelve years ago; and if they had had in those days instruments to shape and carve these beautiful beams and pillars, and entablatures, they would hardly have used pebbles at the ends of sticks in cutting up the buffaloes which they had killed. Besides, the matates we have found are almost positive proof that the people who once resided here ate as food tortillas made of corn; while, from Castañeda's account, one is obliged to believe that the inhabitants of the country which he calls Quivira lived entirely upon the flesh of the buffalo, as the Comanches do at the present day.

Castañeda says likewise that: "The Indians of the country had neither gold or silver, and were not acquainted with the precious metals. The Cacique wore on his breast a plate of copper, which he held in the greatest esteem."

Many have supposed that the ancient Aztecs built the edifices at Gran Quivira, Abó and Quarrá, during their migration from Aztlan toward Anahuac; and that the ruins now found in the Navajo country, and the *Casas Grandes* which are still to be seen along the Gila river, were built by the same people and at about the same period of time. Captain Johnson, of the first dragoons, visited the ruins of the Gila river in November, 1846; from his description of one of the Casa Grande, the largest and best of any he saw, we can discover no point of resemblance between it and these now before us. Captain Johnson says: "After marching six miles, still passing plains which had once been occupied, we saw to our left the *Casa de Montezuma*. I rode to it, and found the remains of the walls of four buildings, and the piles of earth showing where many others had been. One of the buildings is still quite complete, as a ruin. The others had all crumbled but a few pieces of low, broken wall. The large Casa was fifty feet by forty, and had been four stories high; but the floors and roof had long since been burnt out. The charred ends of the cedar joists were still in the wall. I examined them, and found that they had not been cut with a steel instrument. The joists were round sticks, There were four entrances, north, south, east, and west; the doors are about four feet by two. The rooms had the same arrangement on each story. There was no sign of a fire-place in the building, The lower story was filled with rubbish; and above, it was open to the sky. The walls were four feet thick at the bottom, and had a curved inclination inwards to the top. The house was built of a sort of white earth with pebbles, probably containing lime, which abounded on the ground adjacent; and the surface still remained firm, although it was evident they (the walls) had been exposed to great heat from the fire. Some of the rooms did not open to all the rest, but

had a hole a foot in diameter to look through. In other places were smaller holes." Clavigero, the historian, believes that this great movement of the Aztecs from the north towards the south commenced about the year of our Lord 1160, and that Casas Grandes were built by them at various halts which they made in their circuitous journey towards the valley of Mexico. It has been shown that in 1542 there were no buildings of the size and character of the Casas Grandes, or such as are found here now, in all the country called Quivira, which Castañeda visited and described. So one must conclude that, so far as the Aztecs are concerned, whatever they may have had to do with the building of the edifices either in the Navajo country, or on the Gila, or those found 250 miles northwest of Chihuahua, they never planned or constructed those at Gran Quivira.

History represents that Vasquez de Coronada, finding no gold during his great expedition, returned to Mexico, where he fell into disgrace and died in obscurity.

The Spaniards did not return to colonize the province of New Mexico until the year 1581; and the country could not be considered as conquered until 1595. For eighty-five years after this the colony seems to have prospered and to have grown in power. Towns and villages were built, and valuable mines of gold and silver were found and worked with success. The Catholic clergy were aided in their efforts to convert the Indians to christianity by the government, at whose expense large churches were erected in different parts of the province of New Mexico, corresponding with the *missions*, which were built for the same purpose and at about the same period in the other provinces of Texas and California. It was during this time, doubtless, that the large edifices at Abó, Quarrá, and Gran Quivira were erected. It is more than probable that valuable mines of the precious metals were found in their vicinity, and worked under the direction of the Spaniards by the Indians who had been subjugated; for there is every reason to believe that the mountains east of the Rio Grande are at this day rich in gold and silver.

It appears that during these eighty-five years the Spaniards treated the Indians with the most cruel oppression, until finally the latter revolted against them. The night of the 13th of August, 1680, was the time set throughout all New Mexico, when the Indians should rise and make an indiscriminate massacre of all the Spaniards in the country. This plot was made known to Don Antonio de Otermin, then the governor and military commandant of the province, by two Indian chiefs. Every effort was made for defence and to avert the coming storm, but without success. The Indians rose as agreed upon: after various conflicts, they destroyed great numbers of the inhabitants; and, finally, by the latter end of September of that year, succeeded in driving all the rest, with Governor Otermin included, to El Paso del Norte, entirely beyond the confines of the territory.

We have been informed that there is now a tradition amongst the Indians, that as soon as their forefathers had become successful in expelling the Spaniards, they filled up and concealed all traces of the mines where they had toiled and suffered for so many years; declaring

the penalty to be torture and death to any one who should again make known their locality.

Old Mr. Chavis, who overtook us soon after our arrival at Gran Quivira, informed Major Carleton that he had been told, when in his youth, by very old people, that a tribe of Indians once lived here called the *Pueblos* of Quivira; that the Spanish priests came and lived amongst them, in peace and security, for twenty years; that during this period these large churches were erected; and that at the time of the great massacre there were seventy priests and monks residing here—all of whom were butchered excepting two, who contrived to make their escape; that, previous to their massacre, the priests had had intimation of the approaching danger, and had not only buried the immense treasures which had been collected, but had concealed likewise the bells of the churches; that many years afterwards the people of Quivira died off until but few remained; that one of these, a descendant of the chief, knew where the treasures were buried; that the remnant of the tribe afterwards emigrated and joined other Pueblos below El Paso; and that many years ago an old man, one of the last of the tribe, had told in what direction from the church these great treasures had been concealed. So far as the building of the churches and the massacre of the monks and priests are concerned in this account, as well as the final decrease and removal of the people who once lived here, there is no doubt but the story told by Mr. Chavis is, in the main, correct. The account of the depositories of the bells and the treasure is said to have been written down as given from the lips of the last cacique of Quivira, who, at the time he made the disclosure, was living away below Mesilla, on the Mexican side of the river. A copy of this paper has been secured, and is here inserted in the original language, for the benefit of those who may take an interest in such matters.

"En el Semetario de la Parroquia grande en el centro del costado derecho segun la figura numero uno esta una entraña escarbando estan dos campanas tomando la linea de la abertura que dejan las dos campanas se bera al oriente para el callejon que deja la eglesia vieja y el pueblo una lomita a distancia de tres cientas varas mas o menos que no hay otra que forme linea con las campanas debajo de dicha loma hai un sotano de diez o mas varas retacado de piedras el cual tiene el gran tesoro.

"Nombrado por Carlos quinto de la Gran Quivira."*

The grammar of this document is preserved, as in the original. There can be no doubt but the belief that a large amount of gold and silver has been buried here, has for a great number of years been seriously entertained. We find in the cathedral and in the chapel, in every room in the monastery, in every mound of stones in the neighborhood, and in every direction about the ruins, large holes dug, in many places to the depth of ten feet, by those who have come from

* "In the cemetery of the great parish church, in the centre of the right side, according to figure number one, there is a pit, and by digging will be found two bells. By taking the line of the opening left by the two bells, there will be seen to the east, along the lane left by the old church and the town, a hill, at the distance of three hundred yards, more or less, which forms precisely a line with the bells. At the foot of said hill is a cellar of ten yards or more, covered with stones, which contains the great treasure.

"Mentioned by Charles Fifth of Gran Quivira."

time to time to seek for these hidden treasures. Some of these holes look as if they were made more than a century ago, while others appear to be quite recent. Even the ashes of the dead have not been left undisturbed during these explorations. Near the east end of the chapel we saw where the people who had been digging had thrown up a great many human bones, which now lie scattered about. From these we have selected six skulls to send to some one who is skilled in the science of craniology, that he may determine, if possible, to what race of people they once belonged. These skulls are thought to be unusually large.

The ruins of Gran Quivira have hitherto occupied the same position with respect to the boundless prairies which the fabulous island of Atlantis did to the ocean in days of antiquity. No one seemed to know exactly where this city was situated. But the uncertainty of its locality seemed to make no difference in regard to the interest that was felt concerning it; for people would believe in its existence, and receive great pleasure in listening to traditions about its marvellous beauty and magnificence, even when to a reasonable mind those traditions and accounts ran counter to probability.

Men of genius and distinction have taken great pains in following up mazes in the labyrinth of reports concerning it, whether oral or written, and in their glowing descriptions it has appeared almost like a city of enchantment. To them it had paved streets, and fluted columns, and ornate friezes, and sculptured façades; it had the remains of aqueducts and fountains; it had long colonnades, and even barbaric statuary; it had the groined arch, the shouldering buttress, the quaint gargoyle, and everything in outline and in detail that could betoken skill, and taste, and opulence. It was a city, they said, whose inhabitants departed from it so long back in the gloom and mists of the past as to leave in utter obscurity all other records concerning them.

The sphynx, they said, about whose bosom the sands from the Lybian desert had drifted for unknown centuries, was no more of an enigma than this was. Here were palaces and temples, and deserted courts, and long-echoing corridors, and grass-grown streets, and reigning over all a silence so profound as almost to be heard.

Historical societies had taken up these descriptions, and filed them away among their transactions as documents of deep interest. Venerable and learned ethnologists searched in dusty manuscripts and black-letter volumes of antiquity for some authentic account of that race of men who reared and then abandoned such a city. But to this moment their researches have proved fruitless, and the story they seek is still recorded in an unsealed book.

Our business is not that which will permit us to clothe with imaginary grandeur these vestiges of a people whose name has been erased from the book of nations, nor that which will allow us time to indulge in abstruse speculations as to their race or their language. These things belong to the poet and philosopher. With all those pleasant reveries and romantic fancies which these ruins away here on a desert are so wonderfully calculated to awaken we can have nothing to do. We came here to note realities; and now the facts we have seen, the theories we have read which were of value, the traditions we have

heard deserving of attention, and the conclusions to which we have come concerning this interesting place, are all written down. All else save the things we saw admits of doubt, and is obscured by so dark a cloud of uncertainty as to leave much ground for new theories, and for, perhaps, infinitely more valuable conclusions.

We found that the Mescalero Apaches, with whom we had some business of interest, had all gone far towards the south. Our guide, who was a captive amongst them for eight months, gave us some information as to their strength in warriors, which is worthy of record. He says they live in small bands, or families, in order to distribute themselves over a greater extent of country for purposes of hunting. When they are engaged in war, or upon any other enterprise of importance, these bands become united. When separated, they are each controlled by a sub-chief; when acting in concert, they choose a head-man to direct affairs for the time being. The following list shows the name of each of these sub-chiefs and the strength of his band in fighting men:

Santos has forty men;
Josecito has nine men;
Barranca has nineteen men;
Negrito has twenty men;
Jose Largo has fifteen men;
La Pluma has thirteen men;
Santana has nineteen men.

Two chiefs who live in the Sacramento mountains, whose names are unknown, have fifty men.

Add to these the ten sub-chiefs, and we have in this tribe two hundred and eight men capable of bearing arms.

They are represented as having many good rifles, and as being most excellent shots. Living in the neighborhood of the great thorougfare that leads from Texas to California, and having mountain fastnesses in which to take refuge when pursued, they are able, and very willing, to do a great deal of mischief.

From Gran Quivira, the northern point of the Sierra Blanca bears by the compass S. 30° E., and is distant about fifty miles.

The highest point of the Sierra de las Gallinas bears E. 5° N., and is distant about fifteen miles.

The peaks known as Las Tetillas bear N. 36° W., and are distant about fifty-five miles.

We left the ruins about three o'clock in the afternoon, and retraced our steps to the Laguna de la Puerta, where we arrived an hour after dark.

THURSDAY, *December* 22, 1853.

To-day we returned to Manzana, over the same track we had made to the Laguna. Here we encountered a snow-storm. This town is so elevated that hardly a cloud passes the mountains that does not shower upon it either rain, snow, or hail. From what we have observed during our second visit to this place, this Botany Bay of New Mexico, we have concluded that our former estimate of the character of the inhabitants was premature and ill-judged; we now believe that there

is not one single redeeming trait of disposition or habits to be found within its borders.

FRIDAY, *December* 23, 1853.

Our course to-day was about N. 10° W., and lay along the eastern slopes of the Sierra de la Manzana. We faced a snow-storm for nearly the whole forenoon, and were therefore unable to observe much about the features of the country. Six miles 729 yards from Manzana we passed a small mountain stream running towards the east—a mere brook, that is soon lost in the ground. On this there is a little village called Torreon. Two miles 1,181 yards further north we passed another similar brook, and another small town called Tagique. From this last place, over a rolling, broken, and well timbered country, we marched to a small hamlet called Chilili. This town, like Torreon and Tagique, is situated upon a mere rivulet, running from the mountains to the open plains towards the east. Here we encamped in the snow, and suffered much during the whole night from a cold wind from the north.

SATURDAY, *December* 24, 1853.

This morning, before we left camp, an old Mexican brought us some ore, which he said is to be found in great abundance near the Tetilla Peaks, but that it is now covered so deeply in the snow as to be difficult to be procured. We believe the specimen he gave us contains silver. When the snow has melted, it will be worth the trouble, perhaps, to explore these mountains thoroughly, with a view to the discovery of precious metals.

After travelling north for about two miles this morning, we turned off toward the west, by a road that leads to Albuquerque by the Cañon del Infierno. As we ascended the eastern slope of the mountain, we passed through extensive groves of large pine-trees, suitable for boards and other building purposes. The snow was a foot in depth, and the air dry and cold, as in mid-winter in the extreme north. The Cañon del Infierno is 10 miles 562 yards in length. It is very circuitous. The mountains rise abruptly thousands of feet above it on either hand. This makes it a pass of great ruggedness, as well as of a wild and picturesque beauty. Half-way down through it we came to a fine spring of water. The rocks are the same stratified, fossiliferous limestone, which we saw at Los Puertos de Abó. From the mouth of the Cañon del Infierno to Albuquerque, the road descends through an open prairie, entirely destitute of water for the whole distance, which is 20 miles 492 yards.

We arrived at Albuquerque at 8 o'clock in the evening, having marched to-day 36 miles 317 yards.

REPORT

ON THE

FISHES OBSERVED ON THE COASTS OF NEW JERSEY AND LONG ISLAND DURING THE SUMMER OF 1854, BY SPENCER F. BAIRD, ASSISTANT SECRETARY OF THE SMITHSONIAN INSTITUTION.

A period of six weeks spent on the coast of New Jersey, principally at Beesley's point, and Long Island, New York, furnished an opportunity of studying the habits and distribution of the principal species of fishes that are found on that portion of our shores during the summer. Although many others, doubtless, are to be found in the same region, yet none have been introduced except those which were actually caught and carefully examined. A considerable number of the species whose habits and peculiarities are given at some length, have hitherto had nothing placed on record concerning them; and it is hoped that the present article may be found to contain some interesting information, given here for the first time, in addition to its character as a contribution to our knowledge of the geographical distribution of species.

The difference of the names applied to the same species of fish at various points of our coast, even when these happen to be connected very closely, both commercially and geographically, must strike every one with astonishment.

It is scarcely too much to say that no one species of fish bears the same vernacular appellation from Maine to Maryland, still less to Florida or the coast of Texas. This is probably owing to the fact that our shores have been originally settled by various nations from widely remote parts of Europe, each introducing its peculiar nomenclature, or deriving names from the equally isolated aboriginal tribes with their various languages. Thus the names of blue fish, white fish, perch, black fish, bass, king-fish, porgee, hake, tailor, whiting, horse mackerel, shad, smelt, dog-fish, &c., may apply equally to two or more very different species. Among the synonyms of the species will be found the vernacular equivalents in the regions visited, together with some from other localities. It will be sufficiently evident, therefore, that before any species referred to under a trivial name can be identified, the origin of the fish or that of the writer must be ascertained.

Although most of the facts recorded in the following paper have reference to Great Egg harbor, New Jersey, during a period extending from the middle of July to the end of August, it has been thought not amiss to incorporate the results of a visit to Brooklyn, Riverhead, and Greenport, Long Island, as well as to some points on the Hudson river, in September. Some valuable information was thus obtained tending to illustrate more fully the natural history and distribution of the species found on the New Jersey coast.

And here I take occasion to render an acknowledgement for much kind assistance and important information derived from various gentlemen at the different points of operation. Among these I will particularly mention Messrs. Samuel and Charles Ashmead, at Beesley's point, who devoted all their time to the furtherance of my objects

in this exploration. I may also mention Messrs John Stites, Willis Godfrey, Washington Blackman, John Johnson, in fact, most of the residents of Beesley's point. Much benefit was derived at Greenport, Long Island, from the companionship of Mr. E. D. Willard, of the National Hotel, Washington; while to Mr. J. Carson Brevoort, of Bedford, Long Island, well known as the first ichthyologist in New York, and surpassed by no one in his knowledge of our marine species, I am under the greatest obligations. Through the kindness of Mr. John G. Bell, of New York, and Smith Herring, of Piermont, I was enabled to make a complete collection of the fishes of the upper Hackensack and Sparkill.

It must be understood that the present article does not aim at giving a complete account of the species referred to. Such descriptions of color as have been given were in every case taken from the fresh and living fish, the object being to place on record features not usually preserved in alcoholic specimens. Of the species whose colors were known not to fade or alter in spirits no notes of their peculiarities in this respect were taken, while the tints of others were so evanescent as to have escaped or altered before a description could be noted down.

Very little respecting the habits or history of the species has been added from other authors, nor does the nomenclature profess to be at all final as to critical accuracy. To have accomplished this latter object, would have required more time than is at present at my disposal, involving, as it would, the entire revision of American ichthyology generally. The names given are principally those of De Kay in his history of the fishes of New York, and can thus be readily identified.

As will be seen in the course of the article, several of the species collected appear new to science; to these I have been obliged to give names for the sake of proper reference, without at the same time furnishing a complete scientific description. This will, however, be supplied soon through another medium—want of time preventing its being done in season for the present Smithsonian Report. For important assistance in determining the species I am under many obligations to Mr. Girard.

The coast of New Jersey is well known to consist, for most of its extent, of a low beach with sand-hills, separated from the mainland by a wide strip of low meadows filled with small ponds, and intersected by creeks and thoroughfares, which traverse it in every direction. There is no rock or stone of any description, and, consequently, there is a deficiency in the plants and animals which frequent rocky localities. At Beesley's point there is scarcely a pebble of the smallest size to be seen.

The meadows are densely coated with grass, and are covered with water only during unusually high tides.

Beesley's point is situated at the mouth of Egg Harbor river, where it empties into Great Egg Harbor bay. The water is, of course, salt at this point, though somewhat diluted by the volume of fresh water brought down by the river.

The distance from the mouth of the river, or head of the bay, to the inlet on the beach, is about two or three miles; the extreme width about the same, although extending into thoroughfares, through which

a boat may be taken to Absecom on the one side, and to Cape May on other, without going outside of the beach. The mouth of the river is occupied by very extensive beds of oysters, which are celebrated for their excellent flavor. The bottom of the bay is in some part hard and shelly, in others sandy, or again, consists of a soft mud; the latter condition prevails near the shore, or wherever the current is of little strength.

There are numerous mud-flats or sand-bars in the bay, some of them bare at low tide, or nearly so, and occupied by various species of water-fowl. These flats, continuing to increase in height, and at length acquire a growth of grass which fixes still more the accumulating mud and sand, so that in time what was formerly a bar becomes an island elevated some feet above the water.

This transition is, in fact, so rapid, that many of the inhabitants now living have known islands several acres in extent to form within their own recollection.

The greater part of the bottom of the bay and of the thoroughfares, generally, is a soft mud, rich in organic matter, and covered with a profuse growth of *Zostera marina* and algæ of various species. Mr. Samuel Ashmead, who has been engaged for some years in studying the sea-weeds of our coast, has found a much greater variety of species at Beesley's point than Professor Harvey allots to the New Jersey coast. The water being generally shallow except in the channels, the sub-marine vegetation can be seen to great advantage, while sailing over the surface. The water becomes very warm during the summer, and supplies all the conditions necessary for the development of young fishes of many species. The young of all the large fish of the bay may thus be found in greater or less numbers along or near the shore.

The ponds in the meadows, like the waters of the bay itself, are generally muddy at the bottom, sometimes bare of vegetation, and sometimes covered with a thick growth. The fishes found in these ponds consist almost entirely of cyprinodonts of various species, with occasional specimens of *Atherina*, small mullet, or sticklebacks. The creeks likewise contain cyprinodonts, generally of different species from those of the ponds, with young fish of various kinds. Crabs and eels are found everywhere.

The line of beach is two or three miles from the mainland, and consists of a clear white sand raised into hills ten to thirty feet high, a few hundred feet from the water's edge. It is in the inlets at the ends of these beaches that the greatest variety of fish is to be found, particularly in the small indentations, protected from the roughness of the waves, and the bottom of which is covered with *Ceramium* or sea-cabbage.

Corson's inlet, frequently mentioned in the following pages, is situated at the southern end of Peck's beach, which begins directly opposite Beesley's point at the entrance to the harbor, and extends to this inlet over a distance of about five miles.

The only fresh water near Beesley's point is Cedar Swamp creek. This stream, rising in a cedar swamp, and flowing with a very sluggish current, (the water of a chocolate color,) is cut off from the tide

by a dam at Littleworth, three miles from the point. The bottom is very muddy. But little variety of fresh-water fish is to be found in this stream. Several species of *Esox*, two *Leuciscus*, one eel, three *Pomotis*, one each of *Aphredoderus*, *Labrax*, *Etheostoma*, and *Melanura*, and several cyprinodonts. The species are nearly all different from those found in the interior of Pennsylvania on the same latitude.

Another Cedar Swamp creek occurs on the opposite side of Egg Harbor river, in Atlantic county. In many respects it differs from that first mentioned in being of more rapid current, and the bottom at some distance from the tide-water dam consisting of sand or small pebbles. The water too in small quantity is clear, though where of considerable depth it appears almost black. Fewer species of fish were found here than in the other; the only additional one being the *Catastomus tuberculatus*.

Ludley's Run is a small run crossing the road to Cape May, about eight miles from Beesley's point; fresh at low tide but flooded at high water. The only fish found in it consisted of two cyprinodonts, and the *Gasterosteus quadracus*.

Note.—For the sake of avoiding a constant repetition, the initials only of the names of the fins are used. Thus, D. indicates the dorsal fin; C., the caudal; A., the anal; V., the ventral; and P., the pectoral.

LIST OF FISHES.

1. Labrax lineatus, Cuv. and Val.

Rock-Fish—Striped Bass.

Labrax lineatus, Cuv. and Val., Hist. Nat. Poiss. II, 79.—Storer's Report, p. 7.—DeKay, Fauna of New York, Fishes, 7, plate i, fig. 3.

The well known rock-fish, or striped bass, was not caught abundantly during my stay, although occasionally taken in the mouth of the river, and near bluff banks along the thoroughfares. In winter and spring they are captured in considerable numbers in seines, and of a weight extending to twenty or thirty pounds. Individuals of this size are, however, rarely met with. No young ones were seen, as they had not yet returned from the upper portion of the river. At Sing Sing, New York, a few weeks later, several sizes of young were taken.

The rock takes a bait readily, and, from the vigor of its actions, affords fine sport with the rod and reel; the fly is especially adapted to the capture of this species.

As is well known, the rock-fish is the associate of the shad and several species of herring, in a vernal migration from salt water to fresh, for the purpose of depositing their eggs. The development of their young is very rapid, as, when they return to the sea in the fall, they have already attained a length of about four inches; up to a size somewhat greater than this they exhibit decided indications of vertical dark bars, as in the yellow perch, but this fades out in a short time after being taken from the water.

The rock-fish is more abundant in Chesapeake bay and its tributaries than anywhere else to the northward. Here they occur all the year round, and are taken in great numbers. During their migration, they feed voraciously upon the herring bound on the same errand up the fresh water streams. These they ascend to a great height; in the Susquehanna, before the dams were built, reaching the forks at Northumberland, and possibly beyond. The falls of the Potomac offer serious impediments to their passage much above the city of Washington. Arrested in this way, they accumulate in considerable numbers, and afford great sport to the citizens of this place during spring and early summer. The late Mr. Webster was frequently to be seen patiently exercising that skill which made him eminent among the celebrated fishermen of the day.

Owing to its abundance, the rock is the chief staple of the Washington fish-market, where it is to be seen throughout most of the year. It is usually sold at a moderate price, and it is no uncommon thing to have the opportunity of purchasing one of 30 or 40 pounds for 75 cents.

Much interest has been excited in the experiments of Mr. R. L. Pell, of Pelham, Ulster county, New York, in reference to the breeding of rock-fish and shad in fresh waters. I have been kindly furnished by this gentleman with the following communication, which explains his method of stocking fish-ponds.

"I have succeeded in rearing the striped bass, known in our river as the Croton bass, thus: male and female were placed in a small pond, the water of which was salted twice each week until the small fry appeared, when salting ceased. Sixty days after, the old fish languished, and became excessively weak, in which state they continued to exist ten days, when they died. The small fry of both shad and bass grew rapidly, and when six weeks old were placed in a larger pond, and their progeny became fresh-water fish.

"I have a trout pond, which you probably did not see, in which I placed several hundred brook trout, varying from four to twelve inches in length. I was accustomed, for several years, to feed them frequently, and, to my surprise, they became very tame and confiding. On one occasion a large trout followed me around the pond, and so pertinacious was he, that if I suddenly passed around he crossed over; the next day he did the same thing several times, and, finally, I lifted him from the water and discovered a corroded hook in his mouth, after removing which I replaced him in the pond. How can you account for so much instinct in a fish?"

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2. Labrax mucronatus, Cuv. and Val.

White Perch.

Labrax mucronatus, Cuv. and Val., Hist. Nat. Poiss. II, 86, plate xii.—Storer's Report, 8.—*Labrax rufus*, DeKay, Fauna of New York, Fishes, 9, plate iii, fig, 7.

The white perch was at no time during the summer taken in the bay, although in winter they occur there in great numbers, and are caught in seines, with rock-fish, eels, and flounders, which constitute the principal kinds of that season. They are very common in the Tuckahoe river and Cedar Swamp creek, Cape May county; indeed they exist in almost all the creeks of the salt meadows. The largest were taken in the perfectly fresh water of Cedar Swamp creek, above the tide-water dam, and exceeded a foot in length; very few, however, attain this size.

I found them abundant at Sing Sing, New York, in the brackish waters of Croton river; they are also very common, the year round, about Washington.

By setting a net across the current of a creek, at high tide, a great many white perch can usually be caught. I have seen many bushels taken out when the water was low. Great care must be exercised, however, lest the crabs, which are intercepted at the same time, eat holes in the net while nibbling at the fish gilled in the meshes.

The white perch bites readily at a hook, and is frequently caught in this way in great numbers. The flesh is very insipid and rather tough; in fact, the fish is one of the poorest of all the marine species of our coast.

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4. POMOTIS OBESUS, Girard.

Pomotis obesus, Girard in Proc., Boston Soc. Nat. Hist., V, 1854, 40.

General color dark olive green, with six or eight vertical bars of darker on each side, covering a breadth of three or four scales. The skin at the base of the scales, in the space covered by these vertical bars, shows spots of golden purplish; cheeks with narrow lines and spots of the same and similar spots on the basal portion of the membrane of the vertical fins. A. and V. are glossed with metallic green on the interradial portion. Opercular flaps, rich velvet black, bordered (except behind) with a narrow line of golden purple; a crescent of the same on the basal half, the convexity anterior; opercles metallic green. P. transparent olivaceous. In some specimens a distinct vertical bar passes through the eye. In some, too, there is a shade of violet on each side, above the anal fins.

This species was only found in the Cedar Swamp creeks, Cape May county, and Atlantic county, among the splatterdocks, or in small runs or ditches. They were most abundant in muddy water, though occasionally occurring where it was quite clear. Fins nearly black.

This modestly colored species of sun-fish appears to be confined to the fresh water in the immediate vicinity of our Atlantic coast. I first detected it in the boggy brooks near Framingham, Massachusetts, and have since taken it at other points. It was very abundant in the Sparkill, near Piermont, New York, but does not appear to have been caught by any one but myself. Of its southern range along the coast I cannot speak, although a fish strongly resembling it is contained in a collection recently received from Georgetown, South Carolina.

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5. POMOTIS CHÆTODON, Baird.

Banded Sun-Fish.

Pomotis chætodon, Baird.—General form sub-circular; greatest depth of body comprised less than twice its length; dorsal and ventral outlines regularly convex; profile descending towards the snout, which is obtuse. The mouth is small; the eye large, its diameter contained but three times in the length of side of head; spinous portion of dorsal extending over a base nearly equal to that of the soft portion, and almost as high; caudal subtruncated posteriorly and largely developed, and extending a little more posteriorly than the caudal; tip of ventrals extending beyond the three anal spines; pectorals rather small, their extremity reaching as far backwards as the ventrals.

D. X. 11; A. III, 12; C. 4 I. 8, 7, I. 3; V. I. 5; P. 10 or 11. Scales quite large; lateral line concurrent with the dorsal outline.

General color dirty white, with clouds of olivaceous; the tints clearer in smaller specimens; sides of abdomen silvery. Six well defined vertical bands of black on each side, covering each a breadth of two or three scales; the first passes through the pupil across the cheeks; the

second is posterior to the edge of the preoperculum, but interrupted in the middle so as not to cross the operculum; the third is posterior to the first ray of dorsal; the fourth posterior to the spinous rays of anal; the fifth posterior to the end of the dorsal and anal; the sixth passes across the base of the tail. Between the third and fourth bands are short bars, one proceeding from the dorsal, the other from the ventral outline in the same vertical line, and parallel to the others. This may in fact be described as an additional bar interrupted in the middle.

Fins greenish yellow, with mottlings of dark. Ventrals black centrally, yellow posteriorly, and deep red on the two anterior rays and intermediate membrane. Dorsal with the three anterior rays and their membrane black; the membrane between the third and fourth rays red. Pectoral plain.

In large specimens the tints are darker, and the ground color tinged with olivaceous. The red of the dorsal is not distinct. Length three inches.

Abundant in the muddy water of Cedar Swamp creek, Cape May county, New Jersey.

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6. Centrarchus pomotis, Baird.

The Bass Sun-Fish.

Centrarchus pomotis, Baird.—General form elongated, subfusiform in profile; upper and lower lines regularly curved. A depression above the eye. Snout very much abbreviated; lower jaw longest. Mouth large; posterior extremity of maxillary extending to the vertical posterior rim of eye. Diameter of the eye contained about four times in the length of the side of head. Head constituting two sevenths of total length. Six rows of scales above the lateral line; twelve rows beneath. Lateral line concurrent with the dorsal outline. Spinous portion of dorsal quite low, and extending over a base twice as long as the soft portion. Caudal rounded posteriorly. Anal extending a little more backwards than dorsal. Five short anal spines. External soft ray of ventrals extending as a filiform appendage beyond the other rays, which do not reach the anterior margin of the anal. Tip of pectorals extending to a vertical which would intersect the vent.

D. XI. 12; A. V. 10; C. 4. I. 7. 6. I. 3; V. I. 5; P. 12 or 14.

Color.—Dark greenish olive, with three or four irregular longitudinal bands of dull greenish yellow, and occasionally cloudy spots of golden green. Sides of the head of this color, with three indistinct bands of dark olive. A dusky spot at the end of operculum. Iris purplish brown; cornea olive green. Fins quite uniform, very dark greenish olive, with darker margins, except the pectorals, which are light olivaceous, and the ventrals, the spinous rays of which are uncolored. Length six inches.

Some specimens may be better described as dark golden green, with longitudinal bands of dark olive, broken up by cloudings of greenish.

This species was only found in muddy water, or where there was considerable cover. They were stirred out from along the banks. I sometimes thought that they lay at times completely embedded in the mud. They were not rare in Cedar Swamp creek, and I caught a few in the Hackensack, Rockland county, New York.

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7. Aphredoderus sayanus, Lesueur.

Aphredoderus sayanus, Lesueur.—DeKay, New York Fauna, Fishes, 35, plate xxi, fig. 62.

Prevailing color dark olive brown, with occasional obscure dots of lighter. Abdomen and under surface of the throat and head, with the sides of the latter, yellowish, with fine punctations of greenish brown indistinctly visible on the sides. A vertical dark bar beneath the eye. Iris silvery, dotted with black.

D. C. and A. dark olive, with darker margin and base. This character on the tail shows as a vertical bar, parallel to which is another near the base of the tail. P. olive, V. greenish yellow, with cloudings of dusky towards the tip. Lateral line lighter than the ground color.

Largest specimens four and a half inches. Ditches of Cedar Swamp creek, Cape May county.

This species was very abundant in a small branch of Cedar Swamp creek, above Littleworth, where many were taken in a short time.

The size above given is probably a maximum one, as most I have seen from other localities are considerably less. The species is little known to naturalists, although occurring in many streams on the Atlantic coast.

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8. Sphyræna borealis, DeKay.

Northern Barracuda.

Sphyræna borealis, DeKay, New York Fauna, Fishes, 39, plate lx, fig. 196.

Nothing specially noteworthy was observed as to the habits of this diminutive representative of the ferocious barracuda of Florida. None of the specimens caught, in fact, exceeded four inches in length. They were taken from a small cove at Corson's inlet; a few of them were found among the grass at the mouth of the river.

9. Prionotus pilatus, Storer.

Flying Fish.

Prionotus pilatus, Storer, Proc. Bost. Soc. Nat. Hist. II, 77; also, Hist. of the Fishes of Mass. 20, plate vi, fig. 1.

Above mottled olive and reddish brown, with three or four large quadrate spots of darker across the back. The reddish brown spots predominate along the lower part of the sides, in some cases almost forming a longitudinal stripe. Abdomen and inferior part of the body generally reddish white. Head reddish brown, cheeks coppery. Branchiostegal membrane and inside of mouth behind, brownish black. Pupil violet; iris olive-green externally, brassy or coppery internally. Anterior dorsal olivaceous dusky at base, with two or more interrupted bars of pale bluish nearly perpendicular to the rays. A distinct dark spot on the membrane, between the fourth and fifth dorsal spines. Posterior dorsal transparent, mottled or coarsely vermiculated with olivaceous. P. very dark olive-green, with reticulations of a lighter color; chalk-white on the posterior edge of the lower surface. A. C. V. with the pectoral processes reddish brown, brightest along the margin; the former white along the base. Length six inches.

This species was very abundant, and frequently taken with the hook, when its disentanglement proved to be a matter of some danger, on account of the spines of the head. In one instance a man was confined to the house for two weeks in consequence of a puncture received in this way.

When caught, this fish commences a loud croaking or barking, the sound apparently produced in the abdominal region. This is so loud and constant that in hauling a large seine the presence in the net of a single specimen of this gurnard, however small, could generally be determined by the peculiar sound emitted. For this reason it is sometimes called pig-fish by the inhabitants.

The pectoral processes are used as organs of progression, the fish dragging itself slowly upon the bottom by their aid, or raising itself up and resting on their tips. In swimming, or resting, the broad pectoral fins are generally spread out horizontally to their fullest extent—presenting a very beautiful and striking appearance, and closely resembling the wings of some butterfly.

The flesh is sweet, white, and palatable, though on account of its comparatively small size this fish is seldom eaten. Specimens caught on the surf or out at sea are usually much larger than those in the bay, sometimes exceeding a foot in length. It is said to be only a summer visitant.

10. Acanthocottus virginianus, Girard.

The common Sculpin.

Acanthocottus virginianus, Girard, Proc. Bost. Soc. Nat. Hist. III, 1850, 187.—*Cottus virginianus*, Storer, Rep.—DeKay, New York Fauna, Fishes, 51, plate v, fig. 13.

A dried specimen of a sculpin was given me by Mr. Ashmead, which, unfortunately, was mislaid and lost. It was taken in the winter, but does not seem to be abundant.

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11. Boleosoma fusiforme, Girard.

Darter.

Boleosoma fusiforme, Girard, Proc. Bost. Soc. Nat. Hist. V, 41.

The only specimens procured were taken from Cedar Swamp creek, at Littleworth, where it was seen lying motionless at the bottom of the water, darting off swiftly when disturbed.

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12. Gasterosteus quadracus, Mitch.

Stickleback.

Gasterosteus quadracus, Mitch. Trans. Lit. and Philos. Soc. 430, plate i, fig. 11. DeKay, New York Fauna, Fishes, 67, plate vi, fig. 18.

Reddish olive above; sides with a broad but ill-defined band of mottled dark brown, of irregular outline, extending from the snout to the tail, with finer mottlings of the same above and below. This is sometimes broken up into irregular mottlings of dark and lighter brown, with better defined and larger blotches of darker interspersed.

Region of lateral line generally lighter; lower part of cheeks and under parts yellowish silvery; fins, transparent with dark mottlings on the rays; ventrals red behind the anterior spine.

A few specimens were taken, at intervals, in the salt-ponds in the meadows, or among the grass and sea-cabbage of the bay. They were most abundant in Ludley's run, at the crossing of the Cape May road; where the water is perfectly fresh at low tide, and brackish at high water. Here they kept along and underneath the bank, whence they were dislodged with considerable difficulty. This species was also taken in the brackish waters about Sing Sing, New York.

13. LEIOSTOMUS OBLIQUUS, DeKay.

The Lafayette.

Leiostomus obliquus, DeKay, New York Fauna, Fishes, 69, plate lx, fig. 195.

The "Cape May Goody" of the Jersey coast, so called from its great abundance at Cape Island, is very rarely taken in winter, and appears to be rather a summer visitor. It makes its appearance, in large numbers, at Cape May, in August; the first run being composed of quite small individuals, and the larger ones succeeding these. They enter the creeks in crowds, and are caught there in company with the white perch. When perfectly fresh they are most delicious—excelled in flavor by no species on the coast. Their usual size in the bay is about six inches, though occasionally caught measuring ten.

This species is somewhat capricious in its visits to the northern shores; intervals of years sometimes intervening between periods of abundance.

From a coincidence of one of these runs and the last visit of General Lafayette to America, they are known by his name about New York.

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14. OTOLITHUS REGALIS, Cuv. and Val.

Weak Fish—Squeteague—Blue Fish.

Otolithus regalis, Cuv. and Val., Hist. Nat., Poissons, V, 67.—DeKay, New York Fauna, Fishes, 71, plate viii, fig. 24.

Young.—Back greenish, shading into yellowish silvery, with purple reflections on the side. In some specimens there are indications of subvertical blotches on the sides. None of the spots of the adult are seen until the fish exceeds 4 inches in length. D. and C. dusky; P. V. A. yellow; Iris, silvery. Length, 4 inches.

The adult, when first caught, in addition to the markings which are retained in alcohol, presents all over a rich tint of purplish red, which very soon fades out into a dull silvery.

This species, known as blue fish at Beesley's point, weak fish at New York, shecutts at Greenport, Long Island, and trout in Philadelphia and Baltimore, is the species most abundant of all those considered as game by the fisherman. It makes its appearance early in the spring, and leaves for the sea late in the autumn, attaining its period of greatest abundance towards the end of July. It is very easily captured with almost any bait—clam, soft crab, or pieces of fish. Indeed, some of the best sport I ever witnessed with this fish was had by using the eyes of those already caught as bait.

No species on the coast shows so large a count in a successful day's fishing as the weak fish, it being not uncommon for a single boat of three or four men to take from 150 to 250 in an hour or two. When

caught in such numbers, however, the size is not great, perhaps not averaging three-quarters of a pound. The large specimens are generally scattering in their appearance, being seldom taken in numbers. These fish moves about in shoals of greater or less extent, usually swimming pretty near the surface, and requiring for their capture a line leaded very lightly or not at all. They take the bait at a snap, seldom condescending to nibble, thus requiring the line to be kept taut and ready to haul in at a moment's warning. It is, however, only for a short time that they bite voraciously, the run seldom lasting more than one hour.

These fish keep much in the channel ways of the bay and river, when moving, but during ebb-tide, they settle in the deep holes in great numbers, remaining until flood, when they again sally forth. The old stagers are always on the alert to move up to the places of this kind well known to them, and, anchoring their boat, wait patiently for the fish. After passing some time without a nibble, the sport suddenly begins, and, for half an hour to an hour, the excitement of hooking a fish almost the instant the line is dropped, is kept up, when it again as suddenly ceases by the disappearance of the game. The most noted place of this kind about Great Egg harbor is Molasses point, already referred to, where the current is very strong during height of tide, and the great depth of water scarcely extends for one hundred yards.

During the night the weak fish runs much up into the larger creeks of the salt meadows, and, by putting a net across the mouths of these, the weak fish, king fish, and some other species may be penned up and caught in great numbers. In any attempt to retain specimens of moderate size, or of the small species generally, great annoyance is experienced from the crabs, (*Lupa dicantha*,) which are exceedingly abundant, and, arrested by the same operation, leisurely set themselves to work in catching the fish gilled in the net. In so doing, they cut the meshes very badly, in fact some of my best seines were almost totally ruined by them.

The weak fish appears to require, during the summer, a slight dilution of fresh water in the marine element it inhabits, as it concentrates in large numbers about the mouths of rivers in dry weather.

During the excessive drought of the past summer, it was observed that the weak fish was taken much higher up rivers than ever known before. They disappeared almost entirely from Beesley's point about the middle of August, and could only be heard of towards Tuckahoe and higher up. The fishermen prayed devoutly for rain to weaken the waters of the bay, and bring back the weak fish.

At Sing-Sing, New York, and even much higher up the North river, they were taken in numbers in August and September.

The young weak fish were very abundant along the edges of the bay and in the small creeks, of sizes not exceeding four or five inches. It is quite probably that they spawn early in the season, and that these are the fry of the year. At this time they are broadly banded vertically, and, with their much compressed body, would never be referred to the weak fish but for the two prominent canines of the upper jaw. A few only had the spots of the adult.

As a table fish, this species is very much inferior to almost any other

captured on the coast. It looses its rigidity soon after being taken, becoming soft and flabby. It can hardly be used whole a few hours out of the water, and is usually served up cut into short pieces. The flesh, when cooked, is somewhat gelatinous and translucent, very different from the snowy opacity of that of the king fish.

As usual, the fish of this species taken outside in the surf, either with the line or by hauling the net, are much larger than the common run of those in the bay and rivers. The largest I have ever seen weighed about five pounds, though they are said greatly to exceed this occasionally.

When taken, this species makes a peculiar croaking, somewhat like that of *Prionotus*. This is said at times to be heard above water when the fish is at the bottom.

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15. Corvina argyroleuca, Cuv. and Val.

The Silver Perch.

Corvina argyroleuca, Cuv. and Val., Hist. Nat. Poiss. V, 105.—DeKay, New York Fauna, Fishes, 74, plate xviii, fig. 51.

A single specimen only of the adult fish was taken during my stay at Beesley's point. It was caught in the bay by Captain Townsend Stites, and seemed to be unknown to the fishermen.

The young, however, were very abundant in the grass along the edge of the river, of various sizes, not exceeding three inches. They had no markings of any kind, the sides being of a uniform yellowish white.

It is not unfrequently brought to market in New York, where it is known as silver perch.

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16. Umbrina alburnus, Cuv. and Val.

The King-Fish.

Umbrina alburnus, Cuv. and Val.—DeKay, New York Fauna, Fishes, 78, plate vii, fig. 20.

This species is known at Beesley's point as the hake, a name derived probably from its possessing one barbel at the chin, in common with the *Phycis americana*, which bears the same appellation with more propriety. About New York it is called king-fish, and its congener at the south is known as whiting. Everywhere it bears the deserved reputation of being one of the finest fish caught, the sheepshead (*Sargus ovis*) scarcely excepted. Of late years this fish appears to have become quite rare about New York, but they are still abundant on the Jersey coast. At Beesley's point they come next in the count of a day's

sport to the weak fish, although thirty or forty may be considered as a first rate catch for a single boat and tide.

The king-fish makes its appearance in the bays early in the spring, leaving in the fall, and appears to observe much the same periods with the weak fish. Like this species, it is fond of a slight mixture of fresh water, running up the mouths of rivers and ascending in proportion to the duration of dry weather.

During the past summer several were taken at Sing Sing, New York, where they had previously been unknown.

The young fish were exceedingly abundant in the river at Beesley's point, on sandy bottom, as well as in the surf, hundreds being taken at a single sweep of a small net. The smallest were about an inch long, probably the spawn of the spring. As usual, the largest specimens of the fish were caught with nets in the surf, though none that were seen exceeded fifteen inches in length.

The king-fish keeps much in schools, in or near the bottom where it is sandy or hard, preferring the edge of channels or the vicinity of sandbars. They keep about oyster beds, and when oysters are being taken up frequently congregate in large numbers about the boats in eager quest of the worms and other minute animals dislodged by the operation. They bite very readily at clams, crabs soft or hard, and at times make little objection to pieces of fish. The best time for capturing them is on the young flood.

Like the weak fish they at times run up the small creeks in the salt meadows at night, and are taken by intercepting their return with the falling tide. This, however, is by no means so common a habit as with the other species.

The eastern range of the king fish is not extended. Dr. Storer records a single specimen only as having been taken in Boston harbor.

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17. Pogonias fasciatus, Lacép.

The Banded Drum.

Pogonias fasciatus, Lacép., Hist. des Poiss.—DeKay, New York Fauna, Fishes, 81, plate xiv, fig. 40.

Sides yellowish silvery, with six or seven broad, dark, vertical bars between the head and tail. D. and C. dusky towards their borders, the anterior D. quite dark; P. colorless; V. and A. yellow.

The young fish of this species were found very abundantly during August in the small bays along the shore about Beesley's Point. Few were seen in the rivers.

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18. Lobotes emarginatus, B. and G.

Lobotes emarginatus, B. and G. Body elongated, subfusiform in profile; head subconical, contained a little more than three times in the

total length. Posterior extremity of maxillary extending to the vertical line of the anterior rim of pupil; eye circular; its diameter contained about four times in the length of side of head; external soft ray of ventrals continued into a membranous thread extending beyond the other rays, but not reaching the anal fin. Caudal emarginated posteriorly.

D. X. 14; A. III. 8; C. 4, I. 8, 7, I. 3; V. I. 5; P. 15.

Scales well developed; in six rows above lateral line, and fourteen to fifteen below.

General color light olive green, with narrow, well defined longitudinal lines of purplish brown along the sides; one through the centre of each row of scales. These lines, above the lateral line, are parallel to it; below, they are somewhat oblique, ascending behind. A narrow, well defined horizontal line of steel blue passes beneath the eye, tangent to the orbit; a broader one of violet extends through the pupil, parallel to the upper outline of the head.

D. light olive green, the distal half of the spinous portion dull purplish; the membrane elsewhere mottled with purplish brown. C. with rays yellow and red, the membrane mottled with purplish.

A. and V. purplish red anteriorly, yellow behind, the former somewhat mottled. P. greenish yellow. A narrow margin of D. A. and P. pale violet. Length, three inches..

A few specimens were taken, in August, among the grass along the river.

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19. Pagrus argyrops, Cuv. and Val.

The Big Porgee.

Pagrus argyrops, Cuv. and Val., Hist. Nat. des Poiss. VI, fig. 164.—DeKay, New York Fauna, Fishes, 95, plate ix, fig. 25.

About six vertical broad bars of dark purplish brown on each side between head and tail; the first just anterior to the dorsal fin. The intermediate space, when viewed directly, appears of a brownish olive and greenish white mixed; but, held a little obliquely, this resolves into a silvery tint, with well defined longitudinal lines of purplish, a line for each row of scales, and usually along the adjacent edges. Above the lateral line these lines are oblique, and nearly parallel with the dorsal profile anterior to the D. fin. Head above (excepting a lighter bar beneath the eyes), operculum, and an oblique bar beneath the eye rich purplish brown. Back along the dorsal fin and a space on each side of the nape with reflections of rich metallic green. A dark spot on the base of the pectoral bones. Belly white, closely punctate with dark brown.

D. with the rays silvery, the membrane mixed green and purplish brown, the margin clear dark reddish brown. C. brown at base, then greenish, then violaceous white, and ending in dark purplish brown; these colors in rather ill defined V-shaped bands, parallel with the

posterior margin. Extreme tips of caudal lobes of a brighter brown; A. green and purplish brown, bluish towards the edge, which itself is milk white. V. similar. P. transparent, tinged with dusky. Iris dark reddish brown. Length, six inches.

After death, and, indeed, most specimens when fresh caught, exhibit but faint traces of the vertical bars, the sides being silvery, with longitudinal lines of brassy yellow. Iris silvery.

This species is caught with a hook, in water from six to twelve feet deep. They feed on the bottom, and are very destructive to bait, which they nibble off from the large hake and blue fish hooks in a very short time. Few exceeded six inches.

The porgee did not make its appearance in Egg Harbor bay until towards the middle of August, although said to be found at sea at an earlier period. As usual, the specimens were smaller than those taken outside the beach, though exhibiting the same beauty of color. Very few descriptions or figures convey any idea of the variety of delicate tints on this beautiful fish, which fade in a short time after death into a uniform silvery hue.

After the arrival of the porgees in the bay and mouth of the river, they become very troublesome by their great numbers and the destruction of bait caused by their incessant nibbling. A large hook will be cleaned entirely in a moment, while all efforts to catch the depredator prove vain. The only way of taking them is to use a fine line, and very small minnow hooks, baited with small bits of clams, fish, or other food. These will be swallowed boldly, and, as they bite voraciously, large numbers can be taken in a short time. It is only necessary to throw the line out to its full extent, and then at once haul it in slowly, during which movement the bait will generally be seized. A single clam, chopped fine, may serve to catch twenty or thirty.

Quite large porgees are taken about Greenport, Long Island, in very great numbers, with seines. The usual ground is on the east side of Shelter island, where a fishing smack will frequently be loaded at a single haul. During the months of August and September these fish constitute the principal stock of those sent to the New York market over the Long Island railroad. The flesh of the porgee is excellent when fresh—scarcely surpassed by that of any other fish on the coast.

Genus EUCINOSTOMUS, B. and G.

Genus *Eucinostomus*, B. and G.—This genus has been established to include a species of the Menid family, possessing the following generic characters: Mouth small and very protractile; when protruded presenting a subconico-tubular appearance; lips thin; palate and tongue toothless; opercular apparatus without either spines or serratures. The second spine of the anal itself is less developed than in the genus *Gerres*, a genus to which the present one bears a close affinity.

20. Eucinostomus argenteus, B. and G.

Eucinostomus argenteus, B. and G.—Mouth very small; when retracted the posterior extremity of maxillary extends slightly beyond the vertical of anterior rim of the eye; base of spinous portion of dorsal equal in length to that of the soft portion; posterior extremity of soft dorsal rays extending a little more backwards than those of the anal fin.

D. IX, 10; A. III, 7 or 8; C. 5, I, 8, 8, I, 4; V. I, 5; P. 13.

Head forming about one fourth of the whole length; eye large, its diameter contained nearly three times in the length of the side of head; scales large; ground color silvery, with transverse fasciæ of a darker hue in immature specimens.

This species was quite abundant in the latter part of August, in the river and small bays. None were taken exceeding three inches in length.

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21. Cybium maculatum, Cuv. and Val.

The spotted Cybium—Spanish Mackerel.

Cybium maculatum, Cuv. and Val., Hist. Nat. Poiss. XIII, 181.—DeKay, New York Fauna, Fishes, 108, plate lxxiii, fig. 232.

Of this fish but two specimens were taken during my stay at Beesley's point, and the species is scarcely known to the fishermen. It was more abundant at Greenport, Long Island; and in the Peconic bay, towards Riverhead, four hundred were caught at one haul of the seine. The flesh is excellent, having much the flavor of true mackerel, only a little softer and richer.

The fish bears a high price in the New York market, where it has been but recently known. It has been more abundant off our coast generally this season than ever before; and in the lower part of the Potomac, numbers have been taken and salted down. They may frequently be found in this state in the Washington market, and readily recognised by the round yellow spots on the sides, and the size so much larger than that of the common salted mackerel. The posterior portion of the body, to the base of the tail, is slenderer and much more elongated than in the other species.

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22. Lichia carolina, DeKay.

Lichia carolina, DeKay, New York Fauna, Fishes, 114, plate x, figure 30.

Bright silvery, with bluish reflections on the back and upper part of sides; dorsal transparent, dusky towards the tips of the longest soft

rays. C. A. yellowish towards their margin—the latter brightest anteriorly; V. white, tinged with yellow; P. brownish anteriorly. Iris silvery. Length, 5 inches.

This species was very abundant in the edge of the surf on the beach, moving about slowly in small schools. Occasionally they were seen in great numbers in the small slues running up into the beach, where several bushels were frequently taken in a sweep of ten yards with a seine eight feet long. They are most delicious as a pan-fish, and give very little trouble to fit them for cooking, not requiring scaling and scarcely gutting. The only preparation needed is to cut off the head a little obliquely, which will remove all the intestines.

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23. LICHIA SPINOSA, Baird.

The spinous Dory.

Lichia spinosa, Baird.—*Trachinotus spinosus*, DeKay, New York Fauna, Fishes, 117, plate xix, fig. 53.

Similar in colors to the *L. carolina*. The anterior yellow of the dorsal and anal is, however, brighter—even gamboge yellow; basal half of the anal, dusky; ventrals, chalk white, yellow anteriorly. Length, 2½ inches.

Caught in very small numbers with *L. carolina*.

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24. CARANX CHRYSOS, Cuv. and Val.

The yellow Caranx—Yellow Mackerel.

Caranx chrysos, Cuv. and Val., Hist. Nat. Poiss. IX, 97.—DeKay, New York Fauna, Fishes, 121, plate xxvii, fig. 85.

Sides bright wax color, becoming olivaceous along the back; a darker tinge of yellow on the cheek and operculum than elsewhere. In some lights there is a violet reflection on the back. A black spot on the upper part of the posterior edge of the operculum. Dorsals, dark olive green, dusky along the margin; C. dark wax yellow at the base, then lighter yellow—the tips blackish brown; A. dark wax yellow, the margin and spinous portion opaque white; V. white, yellowish centrally; P. greenish yellow. Length, 8½ inches.

Only one specimen of this fish was seen during my stay. It was caught in the bay with a hook. A few more were found among the porgees at Greenport, Long Island.

25. ARGYREIOSUS CAPILLARIS, DeKay.

The Hair-finned Dory.

Argyreiosus capillaris, DeKay, New York Fauna, Fishes, 125, plate xxvii, fig. 82.

One specimen was taken in August while hauling the seine in the surf.

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26. TEMNODON SALTATOR, Cuv. and Val.

The Blue Fish—Horse-Mackerel—Skip-Jack.

Temnodon saltator, Cuv. and Val., Hist. Nat. des Poiss. IX, 225, plate 260. DeKay, New York Fauna, Fishes, 130, plate xxvi, fig. 81.

The blue fish, or horse-mackerel, as it is called at Beesley's point, arrives in the bay early in the spring, accompanying the weak fish in its migration and preying habitually upon it. It is not usual to take them of large size during the summer; later in the season, however, specimens of two and three pounds are not unfrequently captured. Their usual size in August was from eight to twelve inches. The very young ones were found abundant at Corson's inlet, measuring two or three inches in length. At this age they are much more compressed than afterwards.

The blue fish is one of the most voracious fishes on the coast. It bites readily at any object drawn rapidly through the water, as a bone squid, or metal spoon, minnow, white rag, and, in fact, any conspicuous bait. They are generally caught by trolling on the surface of the water, best by sailing back and forth across a channel way, when the wind and tide are in opposite directions. Unless the line is armed with quill near the hook, or wired for a short distance, it is cut off by the sudden snap of their nipper-like teeth, this species ranking with the shark in the facility with which it takes off the hook.

The blue fish keeps near the surface of the water, and frequently leaps some distance into the air. It preys habitually upon the weak fish, and its ravages among the latter species seem to have diminished greatly its numbers off the coasts of New York and New England. It finds, likewise, an easy prey in the schools of Mossbunkers, among which it is said to commit such havoc that the gulls are attracted far and near in quest of the bits of flesh and mutilated fish which float on the surface.

Such congregations of birds often indicate to the fishermen the presence of blue fish on his grounds.

This species, like the weak fish, runs up the mouths of rivers even to where the water is comparatively fresh. Small ones were very abundant at Sing Sing the past summer, and were caught readily from the rocks or along the wharves. They were known as white fish.

They are taken in large numbers in the Potomac river as far up as Acquia creek, as well as in Philadelphia, where they are called tailors.

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27. Peprilus triacanthus, Cuv.

Harvest-Fish.

Peprilus triacanthus, Cuv., Règne Anim. 3d ed.—*Rhombus triacanthus*, DeKay, New York Fauna, Fishes, 137, plate xxvi, fig. 80.

Several specimens were taken in a net at Corson's inlet. They were occasionally seen swimming slowly in small schools close to the steep banks of the inlet. The flesh is said to be tolerably well flavored, though less so than that of many other scomberoid species of the Jersey coast.

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28. Atherinopsis notatus, Girard.

The Silverside—Sand-Smelt.

Atherinopsis notatus, Girard, Proc. Acad. Nat. Sc., Philad. VII, 1854, 198.—*Atherina notata*, Mitch.—DeKay, New York Fauna, Fishes, 141, plate xxvi, fig. 88.

This diminutive species may be said almost to out-number all others on the coast, the cyprinodonts not excepted. It is found quite abundantly everywhere throughout Egg Harbor bay, though of small size; but it is along the sands of the beach and about the inlets that its vast schools are met with. Here they come in with the rising tide, especially when it flows over an extensive tract of sands bare at low water or with only a few pools. At times the water will appear in a state of constant agitation with the attempts of the fish to keep in the edge of the tide as it rolls on, and bushels can be taken in a short time merely with scoop-nets. Several parties, provided each with a fine meshed seine of twenty or thirty feet in length, could readily fill a wagon in a little while. Although no use is made of these "silver sides" on our coast, except as bait, there is no doubt that, potted and prepared as sardines and anchovies, they would be excellent.

With the exception of *Hydrargira flavula*, which is found in large numbers in the same localities, few other fish are met with in these large schools of atherinas. A few scattered *Cyprinodon ovinus* and small mullets only are to be seen. The maximum size to which the atherina attains is about six inches, although fish of this length are seldom caught in the bay. The flesh is nearly translucent and very sweet; and no preparation being required to fit them for the frying-pan.

they might, though comparatively small, be eaten more frequently than they appear to be.

The silver-side, or sand-smelt, as it is called further east, makes an excellent bait for blue fish, weak fish,, and, in fact, almost any other species. It must constitute the chief article of food for the larger fish on our coast, as it is found everywhere, even far up the mouths of rivers. It was very abundant at Sing Sing. In fact, I have seldom drawn a net anywhere in salt water or brackish without seeing it. It is a constant associate of the cyprinodonts in the salt ponds and meadows. It bites readily at a hook, although very seldom swallowing the bait owing to the smallness of its mouth.

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29. Mugil albula, Linn.

The White Mullet.

Mugil albula, L.—DeKay, New York Fauna, Fishes, 146.

Back dark bluish black; sides lustrous silvery; beneath opaque white; a dark bluish black spot on the body, at the base of the pectoral fin; iris silvery, with a yellowish tinge above, as also on the operculum; D. and C. dark bluish on the membrane, especially towards the extremities; P. less strongly marked in the same manner; V. and A. opaque white, the latter with a few brown dots on the rays. Length 4½ inches.

Although small mullets were caught in considerable numbers in the creeks and about the inlets, none of large size were seen. The larger ones do not arrive until September, when they are said to be abundant. They then come close to shore among the grass, and run up the creeks in numbers, even where the water is shallow. When intercepted in a seine they leap over the upper edge with great readiness, one following the other, like a flock of shep. Their maximum size is from eight to ten inches.

This fish becomes extremely fat, so much so as to require no grease in frying. The flesh is said to be very palatable, though rather rich. The large mullets do not remain long in the bay, generally returning to the sea in the fall. A few, however, are said to remain all winter in the salt ponds.

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30. Gobius alepidotus, Bosc.

The variegated Goby.

Gobius alepidotus, Bosc.—DeKay, New York Fauna, Fishes, 160, plate xxiii, fig. 70.

Translucent olive green, with seven or eight vertical lines of lighter along the side; vertical fins, mottled with dusky spots, arranged in series transverse to the rays. Length one inch.

A few specimens only of this rare fish were taken in the grass along the beach of the river.

31. Batrachus variegatus, Les.

Toad-Fish—Oyster-Fish.

Batrachus variegatus, Les., Journ. Acad. Nat. Sc. Philad. III, 398.—DeKay, New York Fauna, Fishes, 171.

Body olivaceous, closely but rather coarsely vermiculated with darker; three or four quadrate spots across and along the back; iris greenish yellow, with four broad double radii of greyish; fins reddish brown towards the borders, their general color light olivaceous; C. and P. with well defined bands of darker, transverse to the rays; D. and A. with similar bands disposed obliquely towards the rays, the angle anterior; a dark spot on the anterior dorsal ; V. and inferior parts of body reddish white—in large specimens, the latter yellowish, with dark blotches. Length six inches.

The toad-fish, or, as it is called at Beesley's point, the oyster-fish, on account of its frequenting the oyster beds, is one of the fishermen's pests, from its great abundance, and pertinacity in taking the hook baited for nobler game. Few fish are more repulsive in appearance than this species, with its large, flattened head, broad mouth, laciniated processes or fringes about the jaw, goggle eyes, and slimy body. It will live a long while out of water, snapping at the finger even when almost dried up. It is capable of inflicting quite a severe bite, and is always handled with a great deal of caution.

The eggs are said to be laid on oyster shells, or between their empty valves, at Beesley's point, in the entire absence of stones or pebbles, which constitute the usual place of deposite. An artificial pile of stone near Chattin's tavern is a favorite locality with them. The eggs are about the size of number 6 shot at first, but enlarge to the bulk of a pea; their color is a bright yellow. The fish watches its nest very vigilantly, and can scarcely be driven away, snapping at the finger or a stick, and when forcibly removed returning with the first opportunity.

The flesh is said, by those who have been able to overcome their aversion to the fish, to be very sweet and palatable.

The toad-fish seldom comes very near shore, few having been taken in the hauling of small seines. I have never seen it up the small creeks.

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32. Tautoga Americana, Cuv. and Val.

Tautog—The Black Fish.

Tautoga americana, Cuv. and Val., Hist. Nat. des Poiss. XIII, 293.—DeKay, New York Fauna, Fishes, 175, plate xiv, fig. 39.

The tautog, smooth black fish, or chub, as the species is indifferently called, was not abundant at Beesley's point during the past summer, although their number is said to be greater in the fall. They are caught off the steep banks, in the channel-ways and the thoroughfares.

The flesh is not very remarkable for its excellence, being greatly surpassed by several other species.

Owing to the toughness of the skin and the firm adhesion of the scales, it is customary to skin the tautog before cooking, whenever of sufficient size to permit it.

Young fish of this species were taken in considerable numbers in the river and about the inlets, when hauling the nets. Their color was generally of a light olive green.

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33. Ailurichthys marinus, B. and G.

Sea Cat-Fish.

Ailurichthys marinus, B. and G., Proc. Acad. Nat. Sc. Philad. VI.—*Galeichthys marinus*, De Kay, New York Fauna, Fishes, 178, plate xxxvii, fig. 118.

The sea-cat or channel-cat, was occasionally taken with the hook in the channel of the river. Nothing specially was learned of its habits. The flesh is very indifferent, being coarse and rank, tasting much like that of small sharks.

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34. Leucosomus americanus, Girard.

Dace.—Wind-Fish—Shiner.

Leucosomus americanus, Girard in Storer, Hist. Fishes of Massach. 117, plate xxi, fig.—*Abramis versicolor*, DeKay, New York Fauna, Fishes, 191, plate xxxii, fig. 103.

This species was very abundant in the fresh waters of Cedar Swamp creek and Cedar creek, two streams emptying into the Egg Harbor river on opposite sides. None were seen excepting in perfectly fresh water above the tide dams. They were in considerable numbers, as being the principal representative of the cyprinoids in the New Jersey streams. This species is found everywhere in the streams of the Atlantic coast to Maine. Nothing of special interest was noted as to its habits.

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35. Catostomus gibbosus, Les.

The Horned Sucker—Chubsucker.

Catostomus gibbosus, Les.—*Labeo gibbosus*, DeKay, New York Fauna, Fishes, 194, plate xxxii, fig. 101.—*Catostomus tuberculatus*, Les.—DeKay, ibid, 199, plate xxxi, fig. 97.

This was the only sucker found in the Cedar creeks, nor is any other species believed to occur there. It is everywhere constantly associated

with the *Leucosomus americanus;* and these, with a small species of *Leuciscus* allied to *L. hudsonius*, constitute almost the only cyprinoids of the fresh waters on our coast. I have seen no other species from New Jersey to Maine in streams emptying directly into the ocean or into brackish waters, except when quite removed from the salt water.

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36. Melanura pygmæa, Agass.

Mud-Fish.

Melanura pygmæa, Agass.—*Leuciscus pigmaeus*, DeKay, New York Fauna, Fishes, 214, plate xlii, fig. 134.

Only one specimen of this species was obtained, caught in a muddy ditch along side the fresh waters of Cedar Swamp creek. Of the five or six species of this genus indicated by Professor Agassiz, all appear to have the same peculiarity of living almost entirely in mud. A locality, which, with the water perfectly clear, appears destitute of fish will perhaps yield a number of mud-fish on stirring up the mud at the bottom and drawing a seine through it. Ditches in the prairies of Wisconsin, or mere bog-holes apparently affording lodgment to nothing beyond tadpoles, may thus be found filled with melanuras. Their usual associates in such places in the west are *Gasterosteus inconstans*, Kirt.

I found none on Long Island, although they doubtless occur in the muddy streams about Riverhead. Mr. J. C. Brevoort, obtained a single specimen near Bedford, and Dr. Ayres some at Brookhaven. This genus appears to be confined to a few points near brackish and salt waters, and to the vicinity of the great lakes; they are especially abundant on the plateaus dividing the waters of the lakes from those of the Mississippi. I have caught them all around Lakes George and Champlain; on the American shores of all the great lakes except Lake Superior; and on their dividing ridges, as already stated, as far west as the Mississippi, in Wisconsin. They have, however, not yet been detected much south of this region in the interior.

This species of *Melanura* is probably identical with *Leuciscus pygmæus* of DeKay, an unfortunate name, as it belongs to an entirely different family than the Cyprinidae, and attains to a larger size than the rest, much larger than many of the *Leucisci*. Specimens taken in Rockland county, New York, and in the same localities whence Mr. J. G. Bell obtained those sent to Dr. DeKay, measure nearly six inches in length. I procured a large number of them during the past summer.

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37. Fundulus zebra, DeKay.

Fundulus zebra, DeKay, New York Fauna, Fishes, 218.

Above, dark olive green, lighter on the sides; on the throat and belly greenish white; 12 to 15 vertical bands on each side of greenish

white, with spots of greenish golden sprinkled in the intervals. Operculum bronzed, iris greenish black, with a narrow golden ring on the inner border; D. and C. dark olive, margined with light grass green, the former with greenish white spots on the posterior half, some of them occasionally confluent; the latter with smaller spots of the same on the membrane, arranged in series transverse to the rays; A. and P. gamboge yellow on the distal half, with black spots posteriorly, the former with some light spots. Length three inches.

Female fishes corresponding to the *F. virilescens* of De Kay, and probably of this species, are uniform olive, with the belly yellowish white. Some specimens have obscure vertical dark lines.

This species is exceedingly abundant in the small creeks of the salt meadows, less numerous in the ponds. They are very active in their movements, darting to cover at the slightest alarm. Like all the other species, they are excessively voracious, and a dead fish of considerable size will be eaten up in a few minutes by the dense crowd of these diminutive scavengers, darting upon it from all points. A clam pounded up and thrown in among them, will in a moment attract many hundreds, and they are frequently taken for bait, by putting the clam into a scoop-net, and withdrawing the net suddenly, with the fish enclosed.

There is no doubt that the various species of cyprinodonts on our coast perform very important services in rapidly removing dead animals, as fishes, crabs, shells, &c., from the water, and thus keeping up the proper equilibrium. This they do to a much greater extent than the crabs, which, however, assist in the labor. Abundant everywhere along the shores and in the creeks and ponds of the meadows, they are always on hand to do their work.

Nothing was observed at Beesley point in regard to the reproductive peculiarities of any of the cyprinodonts, the season of the year not being favorable. It is very probable, however, that most of them are viviparous, like many other species of the family. Like the others, this one is remarkably tenacious of life, resisting successfully long absence from water, even to the extent of considerable desiccation.

A few specimens were caught in the fresh waters of Cedar Swamp creek. They are, however, essentially a salt water species.

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38. Fundulus diaphanus, Agass.

Hydrargira diaphana, Lesueur.—DeKay, New York Fauna, Fishes, 219.

This species was found abundantly in Ludlum's run, at a point where the water is perfectly fresh at low tide, but becomes brackish during high water. It was also taken in the fresh waters of Cedar Swamp creek. I do not remember to have ever noticed it in perfectly salt water.

39. Fundulus multifasciatus, Cuv.

Fundulus multifasciatus, Cuv. and Val., Hist. Nat. des Poiss. XVIII, 200.—*Hydrargira multifasciata*, Lesueur.—De Kay, New York Fauna, Fishes, 220.

This species was found everywhere associated with *H. flavula*, but in quite limited numbers.

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40. Hydrargira flavula, Storer.

Hydrargira flavula, Storer.—*Esox flavulus*, Mitch.—*Fundulus fasciatus*, DeKay, New York Fauna, Fishes, 216, plate xxxi, fig. 98.

This species may be called the giant of the northern cyprinodonts, attaining a size only approached by the females of *Fundulus zebra*. As in *F. zebra*, the female is considerably larger than the male. Specimens were taken nearly eight inches in length.

The *H. flavula* is very rarely found in the bays and meadows, the few that occur in such localities being very small, and much scattered. It is along the beach, and about the inlets, that the immense numbers that exist on our coasts can be appreciated. As the tide is rising and flowing over flat sands, or up the narrow shores and channel ways, this species will be seen in dense schools, slowly swimming with the tide, and readily recognised by its large size and the light spot near the dorsal fin.

It generally keeps distinct from the atherinas, which are equally or even more abundant in the same situations. A few *Cyprinodon ovinus* are sometimes seen in company, rarely any other species of the same family.

The sexes of this species are conspicuously different in marking, the male having many broad vertical bands on each side, from head to tail, the female two or three longitudinal ones.

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41. Hydrargyra luciæ, Baird.

Hydrargira luciæ, Baird.—General form elongated, though of rather short appearance. Head constituting less than one-fourth of total length. Insertion of anal slightly in advance of origin of dorsal, and rather more developed than the latter. Vertrals very small; their extremity reaching the anus. Tail large. D. 8; A. 9; C. 6, I. 8, 7, I. 5; V. 6; P. 15.

Dark olive green above, lower part of sides and beneath rich ochre yellow. Sides with 10 or 12 broad, well defined, vertically disposed dark bars, nearly as large as their inter-spaces, which are of a faint tint of greenish white. All the fins but the dorsal are of a uniform yellowish, lighter than the abdomen. Dorsal, yellow on the terminal

half, the basal portions olivaceous, with a large black spot posteriorly, and immediately anterior to it a white one. The dark spot is bordered above and behind by the yellow part mentioned. In one specimen the posterior half of the base of the dorsal fin is dull white, with a large subcircular spot of black in the centre. Length about one inch.

P. similar, the dorsal unspotted, the yellow less intense.

A few specimens only were taken, in a small ditch at Robinson's landing, Peck's beach, opposite Beesley's point.

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42. Cyprinodon ovinus, Val.

Cyprinodon ovinus, Valenc.—*Esox ovinus*, Mitch.—*Lebias ovinus*, DeKay, New York Fauna, Fishes, 215, plate xxvii, fig. 87.

This species was very abundant in the salt ponds, more so than any other; it was seen but rarely in the creeks or in the bays. Specimens were taken of much larger size than the supposed average; and the males, recognised by the black band on the end of the caudal fin, were found to be larger than the females.

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43. Cyprinodon parvus, B. & G.

Cyprinodon parvus, B. and G.—Form elongated, resembling a diminutive *Leuciscus;* head constituting less than a fourth of the total length; eye quite large and circular, being contained three times in the length of the side of the head; caudal posteriorly rounded.—D. 10; A. 10; C. 5. I. 7. 6. I. 4; V. 6; P. 15. Scales quite large, deeper than long, and disposed in eight longitudinal series upon the line of greatest depth of the body; seven series may be observed upon the peduncle of the tail.

This species was found in the small ponds of the salt meadows, generally in the grass; and owing to their diminutive size the males were not often taken, and, in fact, neither sex was found in anything like the abundance of most other species. The colors during life were very plain, being without any of the peculiar patterns of other species. I observed it, sparingly, in many localities in Long Island, especially at Greenport. It has a close resemblance to the females of *Heterandria*.

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44. Esox fasciatus, DeKay.

Short-billed Pike.

Esox fasciatus, DeKay, New York Fauna, Fishes, 224, plate xxxiv, fig. 110.

Brownish olivaceous; a longitudinal lighter vertebral stripe. On each side of the body a median longitudinal irregular band of golden,

sending off bars transversely above and below, sometimes opposite each other, sometimes alternate, occasionally branching and anastomosing. Beneath greenish or yellowish white. Iris purplish brown, with a golden interior ring.

Dorsal and caudal fins plain olive, tinged with red. A. V. P. pink—this color becoming rather deeper after death. Length, 10 inches. Abundant in Cedar Swamp creek. Specimens of considerably larger size were taken.

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45. Esox reticulatus, Les.

Pickerel.

Esox reticulatus, Les.—DeKay, New York Fauna, Fishes, 223, plate xxxiv, fig. 107.

Rather rare in Cedar Swamp creek. Associated with *E. fasciatus*.

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46. Belone truncata, Les.

The Bill-Fish—Sea-Pike—Silver Gar-Fish, &c.

Belone truncata, Lesueur.—DeKay, New York Fauna, Fishes, 227, plate xxxv, fig. 112.

Color.—Back dark green; sides opaque silvery white; beneath dull white—the lines of separation between these colors very distinct; cornea green; iris silvery; fins subtransparent, with fine punctations of greenish on the membrane, much thickest on the D. and C.; length, 8 inches.

The silver gar made its appearance, in August, in considerable numbers, though of quite small size. It was found in the shallow bays and creeks—more abundantly in the slues on the beach, keeping in compact bodies, and swimming slowly along.

This species is fond of running up into fresh water during the summer, and is often taken a considerable distance from the ocean. I have seen them in the village of Riverhead, Long Island; and they are at times quite abundant off the city of Washington. They have been seen at Columbia, Pennsylvania, in the Susquehanna. They sometimes are taken with a hook, although such an occurrence is quite rare. When of large size, their flesh is of excellent flavor.

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47. Saurus mexicanus, Cuv.

Saurus mexicanus, Cuv., Règne Anim.—(Griff. transl.) X, 431.

A single specimen of this fish was taken in a seine in the river. Although abundant off the southern coast, it is rarely seen so far to the

north. Dr. DeKay does not enumerate it among the fishes of New York, yet several have been procured by Mr. Brevoort about Long Island.

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48. Engraulis vittata, B and G.

The Anchovy.

Engraulis vittata, B and G.—*Engraulis mitchilli*, Cuv. and Val., Hist. Nat. Poiss., XXI.—*Clupea vittata*, Mitch.—DeKay, New York Fauna, Fishes, 254.

It is a little remarkable that no mention of the occurrence of *Engraulis* on the Atlantic coast of the United States, is made by any American writer. The species was long ago described by Dr. Mitchill, so accurately as clearly to indicate this genus; but Dr. DeKay does not appear to have noticed it at all.

The anchovy made its appearance early in August in the shallow waters along the beach, although of very small size. They became subsequently more abundant; and towards the end of the month, while hauling a large net in the surf, many were taken measuring over six inches in length. As the meshes of the net were very large, the greater portion readily escaped; but with a seine properly constructed enough could be readily procured to supply the American market.

I procured several specimens of this fish, in 1847, at the residence of Mr. Audubon, on the Hudson river, above New York.

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49. Alosa menhaden, Mitch.

The Moss-Bonker—Bony Fish—Hard Head.

Alosa menhaden, Mitch.—Storer, Rep., p. 117.—De Kay, New York Fauna, Fishes, 259, plate xxi, fig. 60.

Back dark green, shading into yellowish, silvery on the sides and beneath. Iris silvery. A rounded dark spot behind the upper part of the operculum, and five or six smaller ones, less distinct, in a longitudinal row behind it, the latter sometimes indistinct. All the spots are on the skin, showing through the transparent scales.

D. and C. yellowish, with a dark margin; the remaining fins colorless.

The moss-bonker is a fish of great economical importance, as much so, perhaps, as any other on our coast. This is not on account of its flesh, which, though sweet, is too full of bones to be generally acceptable; as a manure, however, it replaces all other fertilizers on and near the sea-shore.

The countless schools of moss-bonkers, most of them of vast extent, seen everywhere on the Atlantic coast, represent a species quite equal in numbers to any other of the same size belonging to our fauna.

Every bay and river-mouth along our coast is filled with them during the summer, and they can everywhere be taken with great ease. The schools swim at the surface, their dorsal fins projecting above the water, and keeping it in such agitation as to be readily discernible at a great distance. They are generally followed by blue fish, sharks, and other predacious species, which commit such havoc in their ranks, it is said, that the gulls frequently follow in their wake to feed upon the fragments left floating behind.

The fishermen about Greenport, when in pursuit of moss-bonkers, lie some distance off shore, with two seines joined together, each seine resting on a separate boat, provided with its crew. When a school is seen of sufficient size to warrant the trouble, the joined ends of the nets are dropped into the water, and as the boats separate they make a turn, and thus enclose the fish; the ends of the nets are then taken to the shore, and the net itself drawn up by means of a windlass. Many thousands are taken at a haul, and meet with a ready sale. Quite recently several establishments have been erected on Long Island for the manufacture of oil from the moss-bonker. The fish, as brought in, are chopped up and boiled, and the oil skimmed off; a heavy pressure on the residuum expresses the remaining oil, and what is left is still useful as a manure. The oil finds a ready market. It has been estimated that a single fish will furnish enough oil to saturate a surface of paper eighteen inches square.

Most of these fish, however, are used directly as fertilizers, by being ploughed or hoed in the ground. It is quite customary when planting corn to place a fish in each hill, the result being seen in a very luxuriant growth of the plant.

Besides being taken in the manner just described and by single seines put out from the shore, many are captured in gill-nets set in channels of rivers and other localities frequented by them. Many are taken in this way in the Hudson river and tributaries, as well as elsewhere.

Besides its use as manure, the moss-bonker, from its abundance, is employed to a great extent as bait for other fishes. Chopped up fine, it constitutes a chief bait for eels in eel-pots, and the flesh is very attractive to the blue fish and other species. When used as food, it is usually skinned, to remove the oilier layer of black fat, and the back bone is generally taken out at the same time.

The moss-bonker is much infested by a species of lernaean, which is buried in the skin by its star-shaped processes with a long projecting thread.

The moss-bonker is not much sought after at Beesley's point, nor did I hear of any who made a business of catching them there for manure.

50. ALOSA MATTOWACA, DeKay.

Alosa mattowaca, DeKay, New York Fauna, Fishes, 250, plate xl, fig. 127.—*Clupea mattowaca*, Mitch.

A few specimens were caught in the surf with a large seine.

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51. ALOSA TERES, DeKay.

Alosa teres, DeKay, New York Fauna, Fishes, 262, plate xl, fig. 128.

A number of specimens of this rare species were found one day in the edge of the surf along the beach; they seemed to be very weak, and died soon after their capture.

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52. CHATOESSUS SIGNIFER, DeKay.

Thread-Herring.

Chatoessus signifer, DeKay, New York Fauna, Fishes, 264, plate xli, fig. 132.

A few specimens were taken in a net in the bay. In life the back is bright green; the caudal fin yellow, black at the tip.

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53. PLATESSA OCELLARIS, DeKay.

The long-toothed Flounder.

Platessa ocellaris, DeKay, New York Fauna, Fishes, 300, plate xlvii, fig. 152.

This flounder is caught very abundantly during the summer, especially in the month of July, when it frequently constitutes the chief result of a day's fishing. It is generally found on sandy bottoms, and bites readily at almost any bait. They are sometimes taken in large numbers by means of nets in the deep slues along the beach.

In winter they at times seem to be quite torpid on the shallow grounds, suffering themselves to be taken up with oyster tongs without making any attempt to escape.

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54. PLATESSA PLANA, Storer.

The New York Flat-Fish—Winter Flounder.

Platessa plana, Storer.—DeKay, New York Fauna, Fishes, 295, plate xlviii, fig. 154, and plate xlvix, fig. 158.

A few specimens only of this species were taken in the shores on the beach. It is said to be found abundantly in the bay during winter.

55. Rhombus maculatus, Girard.

The spotted Turbot.

Rhombus maculatus, Girard, in 7th Ann. Rep. Reg. Univ. N. Y., on State Cab., 23.—*Pleuronectes maculatus*, Mitch.—DeKay, New York Fauna, Fishes, 302, plate xlvii, fig. 151.

Taken occasionally of small size in the surf.

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56. Achirus mollis, Cuv.

The New York Sole.

Achirus mollis, Cuv., Règne Anim., II.—DeKay, New York Fauna, Fishes, 303, plate xlix, fig. 159.

A few specimens were caught in the river by means of seines. The species, though resident, is taken most frequently in early spring. When thrown on the shore it buries itself in the sand, and is out of sight in a few moments. It is familiarly known at Beesley's Point under the name of hog-choker, as when seized by the hogs it doubles itself up, and, filling the æsophagus, obstinately resists by the scabrous nature of its scales all effort on the part of the animal to swallow it.

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57. Anguilla tenuirostris, DeKay.

Anguilla tenuirostris, DeKay, New York Fauna, Fishes, 300, plate liii, fig. 173.

As might be expected from the vast mud-flats of the bay and its generally muddy bottom, eels are exceedingly abundant about Beesley's point. In passing slowly over the shallow waters near the shore, they will be seen darting out from among the sea-weeds at the bottom every few rods, and may readily be captured by a skillful hand armed with a gig. They can be caught readily, likewise, by means of a hook and line, by bobbing, with eel-pots, and the other devices suitable to the capture of the genus. Night is, of course, the best time for taking them in any way.

In winter they bed in the soft mud, to the depth of about a foot, and are then easily secured by means of a broad gig or spear.

58. Conger occidentalis, DeKay.

The Conger Eel.

Conger occidentalis, DeKay, New York Fauna, Fishes, 314, plate liii, fig. 172.

Clear olive above, shading into silvery on the sides and beneath. Vertical fins thin and transparent, with a narrow and well defined margin of brownish black. Iris, silvery. After death the silvery hue is more predominant.

Only one specimen of this species was taken at Beesley's point. It was captured on the 16th of August at Molasses point, and seemed entirely unknown to the residents.

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59. Ophidium marginatum, DeKay.

Ophidium marginatum, DeKay, New York, Fauna, Fishes, 315, plate lii, fig. 169.

One specimen was taken during the past winter, and presented by Mr. Chatten.

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60. Syngnathus viridescens, DeKay.

The Green Pipe-Fish.

Syngnathus viridescens, DeKay, New York Fauna, Fishes, 321, plate liv, fig. 176.

This pipe-fish was very abundant in the sea-weed and grass near the mouths of the inlets, every haul of the net bringing in hundreds. They were of many shades and colors, and of sizes varying from one inch to eight.

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61. Diodon maculato-striatus, Mitch.

The Spot-Striped Balloon-Fish.

Diodon maculato-striatus, Mitch.—DeKay, New York Fauna, Fishes, 323, plate lvi, fig. 185.

A few specimens were taken in the river.

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62. Diodon fuliginosus, DeKay.

Diodon fuliginosus, DeKay, New York Fauna, Fishes, 324, plate lv fig. 181.

A few specimens captured in the river by means of a seine.

63. Tetraodon turgidus, Mitch.

Toad-Fish.

Tetraodon turgidus, Mitch.—DeKay, New York Fauna, Fishes, 327, plate lv, fig. 178.

Dark olive green above and on the upper part of the sides, with fine black points intermixed. Abdomen and beneath, pure opaque white. Lower part of sides ochre yellow, with six or seven large vertically oblong and rounded blotches of brown. Above these are occasionally traces of dark mottling; fins pale yellowish. Iris reddish brown, with an inner circle of a coppery or brassy color.

This fish is frequently caught in the bay of Great Egg harbor, while fishing for better species. When drawn up, it immediately inflates its body to a prodigious size by means of short jerking inspirations, the sac becoming distended with air if in the atmosphere, or water, when submerged. By scratching it on the belly or pounding it, it will readily inflate itself several times in succession, and again discharge its load at a single effort through mouth and gills. When inflated and thrown on the water, it will sometimes float to a great distance before collapsing.

The skin around the eye of this species is contractile to such an extent as completely to close up the latter by a kind of puckering.

This fish is most abundant in summer; rarely, if ever, taken during the winter, and only occasionally in early spring.

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64. Carcharias cæruleus, DeKay.

The small blue Shark.

Carcharias cæruleus, DeKay, New York Fauna, Fishes, 349, plate lxi, fig. 200.

The blue shark was quite abundant in the bay during the summer, and quite a number were captured by various parties. They were taken by means of large shark-hooks baited with eels or other fish, a small keg being used as a float. Several of the boats always carried shark-lines, which were put out when on suitable ground, the buoy being allowed to float off to some distance. On getting a bite the small lines would be taken up, the anchor raised, and every effort made to tire out the shark. Sometimes the fish would be towed to an island and hauled up, or again drawn in to the side of the boat, and killed by means of a harpoon or sword. The largest taken in this way was about nine feet long.

Though sufficiently abundant to be seen any day swimming with their dorsal fins above the surface, no instance was mentioned by the inhabitants of their attacking bathers while in the water.

Small specimens were occasionally taken on hooks baited for other fish.

65. Mustelus—canis, DeKay.

The Hound-Fish—Dog-shark.

Mustelus, Mitch., *canis*, DeKay, New York Fauna, Fishes, 355, plate lxiv, fig. 200.

The little dog-shark was sufficiently abundant to constitute a grievous pest to those who aimed after something more edible. It was no uncommon thing to see from ten to twenty taken in a few hours' fishing. They bite at almost any bait, and their presence is generally fatal to much success among other species. The flesh is not very palatable, having much of the coarse and rank flavor of the sea cat-fish.

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66. Zygæna tiburo, Val.

Zygæna tiburo, Val.—Yarrell, Brit. Fish., I, 507—*Squalus tiburo*, Linn. Syst. Nat. I, 399, 6.

Only one specimen of this shark was obtained, although several were taken by the fishermen. This one was caught by Mr. Charles Ashmead, in the bay, and measured about eighteen inches. The *Z. malleus* is also said to occur even more abundantly than the present species. I do not find this species recorded hitherto as occurring on the American coast.

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67. Pastinaca hastata, DeKay.

The Whip Sting-ray.

Pastinaca hastata, DeKay, New York Fauna, Fishes, 373, plate lxv, fig. 214.

This species was found to be abundant in the bay and elsewhere. It was frequently taken with the hook, and every haul of the seine in the surf brought in numbers. The smallest caught were about the size of a breakfast plate, the largest measured about four feet across, with a tail five feet long.

The wounds inflicted by means of the serrated spine on the tail of the sting-ray are justly dreaded by the fishermen, who use the greatest care in handling them. The usual practice is to cut off the tail at once, and thus render the fish *hors du combat*. Instances have been known of this spine being driven through the hand with such violence as to render it necessary to pull it out from the opposite side.

The large ones, when brought in by the seines, are so heavy as materially to impede the hauling of the net. In this case some of the men were in the habit of thrusting the handle of an oar into the orbit, and with this convenient *point d'appui* sliding the monster out upon the bank.

Catalogue of rocks, minerals, and ores, collected during the years 1847 and 1848, on the Geological survey of the United States mineral lands in Michigan, by Dr. C. T. Jackson, United States geologist, and deposited in the Smithsonian Institution.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
1	1	1	Cocks' comb sulphate of baryta and dog tooth spar	New York Company, near Agate Harbor
2	2	1	Cocks' comb sulphate of baryta and calc. spar	do
3	3	1	Cocks' comb sulphate of baryta	do
4	4	1	Do. do	do
5	5	1	Do. do	do
6	6	1	Do. do	do
7	7	1	Do. do	do
8	8	1	Do. do	do
9	9	1	Do. do	do
10	10	1	Do. do	do
11	11	1	Do. do	do
12	12	1	Do. do	do
13	13	1	Do. do	do
14	14	1	Do. do	do
15	15	1	Do do	do
16	16	1	Do. do	do
17	17	1	Do. do	do
18	18	1	Do. do	do
19	20	1	Cocks' comb sulphate of baryta, with sulphate of baryta and black sulphuret of copper	do
20	65	1	Sulphate of baryta and black sulphuret of copper, mixed	do
21	66	1	Do. do	do
22	67	1	Do. do	do
23	68	1	Do. do	do
24	69	1	Sulphate of baryta containing black sulphuret of copper coated with green carbonate of copper	do
25	70	1	Do. do. do	do
26	71	1	Calc. spar and radiated sulphate of baryta	do
27	25	1	Fine crystals of calc. spar	do
28	26	1	Calc. spar, six-sided prisms	do
29	27	1	Calc. spar, scalene dodecahedrons	do
30	28	1	Geodes of calc. spar	do

31	29	1	Do	do
32	30	1	Crystals of calc. spar	do
33	31	1	Crystals of calc. spar colored by black sulphuret of copper	do
34	32	1	Do . . . do	do
35	33	1	Single crystal of calc. spar	do
36	34	1	Fine crystals of calc. spar	do
37	35	1	Calc. spar	do
38	36	1	Do	do
39	37	1	Do	do
40	38	1	Do	do
41	39	1	Do	do
42	40	1	Do	do
43	41	1	Do	do
44	42	1	Calc. spar colored by black sulphuret of copper	do
45	43	1	Do . . . do	do
46	44	1	Yellow dog-tooth spar	do
47	46	1	Calc. spar	do
48	47	1	Do	do
49	48	1	Do	do
50	49	1	Do	do
51	50	1	Do	do
52	51	1	Do	do
53	52	1	Black sulphuret of copper and calc. spar colored by black sulphuret of copper	do
54	53	1	Black sulphuret of copper on calc. spar	do
55	54	1	Black calc. spar colored by black sulphuret of copper	do
56	55	1	Do . . . do	do
57	56	1	Do . . . do	do
58	57	1	Do . . . do	do
59	58	1	Do . . . do	do
60	59	1	Dog tooth spar and black sulphuret of copper	do
61	61	1	Do . . . do	do
62	61	1	Blue calc. spar	do
63	62	1	Do	do
64	63	1	Blue calc. spar and black sulphuret of copper	do
65	64	1	Do . . . do	do
66	714	7	Calc. spar, six-sided prisms	do
67	972	10	Vein of brecciated limestone	do
68	593	6	Amygdaloid containing red feldspar	do
69	74	1	Native copper and black sulphuret of copper in red amygdaloid	Eagle Harbor mine
70	75	1	Do . . . do . . . do	do
71	76	1	Do . . . do	do

Catalogue of rocks, minerals, and ores, collected during the years 1847 and 1848, on the Geological survey of the United States mineral lands in Michigan, by Dr. C. T. Jackson, United States geologist, and deposited in the Smithsonian Institution.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
1	1	1	Cocks' comb sulphate of baryta and dog tooth spar	New York Company, near Agate Harbor
2	2	1	Cocks' comb sulphate of baryta and calc. spar	do
3	3	1	Cocks' comb sulphate of baryta	do
4	4	1	Do. do	do
5	5	1	Do. do	do
6	6	1	Do. do	do
7	7	1	Do. do	do
8	8	1	Do. do	do
9	9	1	Do. do	do
10	10	1	Do. do	do
11	11	1	Do. do	do
12	12	1	Do. do	do
13	13	1	Do. do	do
14	14	1	Do. do	do
15	15	1	Do do	do
16	16	1	Do. do	do
17	17	1	Do. do	do
18	18	1	Do. do	do
19	20	1	Cocks' comb sulphate of baryta, with sulphate of baryta and black sulphuret of copper	do
20	65	1	Sulphate of baryta and black sulphuret of copper, mixed	do
21	66	1	Do. do	do
22	67	1	Do. do	do
23	68	1	Do. do	do
24	69	1	Sulphate of baryta containing black sulphuret of copper coated with green carbonate of copper	do
25	70	1	Do. do. do	do
26	71	1	Calc. spar and radiated sulphate of baryta	do
27	25	1	Fine crystals of calc. spar	do
28	26	1	Calc. spar, six-sided prisms	do
29	27	1	Calc. spar, scalene dodecahedrons	do
30	28	1	Geodes of calc. spar	do

31	29	1	Do.	do.
32	30	1	Crystals of calc. spar.	do.
33	31	1	Crystals of calc. spar colored by black sulphuret of copper.	do.
34	32	1	Do. do.	do.
35	33	1	Single crystal of calc. spar.	do.
36	34	1	Fine crystals of calc. spar.	do.
37	35	1	Calc. spar.	do.
38	36	1	Do.	do.
39	37	1	Do.	do.
40	38	1	Do.	do.
41	39	1	Do.	do.
42	40	1	Do.	do.
43	41	1	Do.	do.
44	42	1	Calc. spar colored by black sulphuret of copper.	do.
45	43	1	Do. do.	do.
46	44	1	Yellow dog-tooth spar.	do.
47	46	1	Calc. spar.	do.
48	47	1	Do.	do.
49	48	1	Do.	do.
50	49	1	Do.	do.
51	50	1	Do.	do.
52	51	1	Do.	do.
53	52	1	Black sulphuret of copper and calc. spar colored by black sulphuret of copper.	do.
54	53	1	Black sulphuret of copper on calc. spar.	do.
55	54	1	Black calc. spar colored by black sulphuret of copper	do.
56	55	1	Do. do.	do.
57	56	1	Do. do.	do.
58	57	1	Do. do.	do.
59	58	1	Do. do.	do.
60	59	1	Dog tooth spar and black sulphuret of copper	do.
61	61	1	Do. do.	do.
62	61	1	Blue calc. spar.	do.
63	62	1	Do.	do.
64	63	1	Blue calc. spar and black sulphuret of copper	do.
65	64	1	Do. do.	do.
66	714	7	Calc. spar, six-sided prisms	do.
67	972	10	Vein of brecciated limestone.	do.
68	593	6	Amygdaloid containing red feldspar	do.
69	74	1	Native copper and black sulphuret of copper in red amygdaloid.	Eagle Harbor mine.
70	75	1	Do. do. do.	do.
71	76	1	Do. do.	do.

Catalogue of rocks, minerals, and ores, collected by Dr. C. T. Jackson—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
72	77	1	Native copper and black sulphuret of copper in red amygdaloid	Eagle Harbor mine
73	78	1	Veinstone and black sulphuret of copper	do
74	79	1	Do. do	do
75	80	1	Do. do	do
76	81	1	Do. do	do
77	82	1	Veinstone	do
78	83	1	Do	do
79	321	3	Native copper in laumonite	do
80	322	3	Do. do	do
81	323	3	Do. do	do
82	324	3	Do. do	do
83	529	5	Native copper in veinstone	do
84	531	5	Native copper in analcime, with calc. spar colored green by carbonate copper	do
85	534	5	Native copper with analcime	do
86	19	1	Red amygdaloid	do
87	606	6	Native copper in laumonite	do
88	709	7	Amygdaloid, with native copper in crystals of calc. spar, with red feldspar	do
89	710	7	Massive native copper in veinstone, with laumonite	do
90	711	7	Do. do. do. do	do
91	712	7	Do. do. do. do	do
92	713	7	Do. do. do. do	do
93	715	7	Dentritic native copper in veinstone, with laumonite	do
94	716	7	Do. do. do. do	do
95	717	7	Mass of native copper, with laumonite	do
96	718	7	Dark red compact sandstone	do
97	719	7	Trap, mixed with sandstone, coated with light green chlorite	do
98	720	7	Fine-grained compact trap, containing chlorite finely disseminated	Eagle harbor
99	721	7	Trap, containing scattered nodules of chlorite	do
100	722	7	Do. do. do	do
101	723	7	Amygdaloid, containing amygdaloid of chlorite calc. spar and laumonite	do
102	732	8	Mass of native copper in laumonite	West Vein harbor
103	733	8	Do. do. do	do
104	734	8	Mass of native copper in chlorite	do

105	735	8	Do.......do..........do	do.
106	736	8	Native copper in laumonite	do.
107	737	8	Do...........do.	do.
108	738	8	Do...........do.	do.
109	739	8	Do...........do.	do.
110	21	1	Native copper coated with red oxide	Northwest corner of Kewconaw point
111	22	1	Native copper in quartz	do.
112	23	1	Native copper in quartz and phrenite, with red oxide	do.
113	24	1	Do.	do.
114	72	1	Do.	do.
115	73	1	Phrenite and quartz	do.
116	512	5	Native copper in phrenite	do.
117	513	5	Do...........do.	do.
118	514	5	Do...........do.	do.
119	515	5	Native copper and calc. spar	do.
120	516	5	Native copper in calc. spar	do.
121	517	5	Do...........do.	do.
122	518	5	Do...........do.	do.
123	519	5	Mass of native copper	do.
124	520	5	Do.....do.	do.
125	521	5	Native copper coated with red oxide, with fine crystals of green carb. copper	do.
126	522	5	Native copper in red feldspar	do.
127	523	5	Crystals of calc. spar	do.
128	524	5	Native silver and copper in veinstone, containing flesh-colored weak quartz ore	do.
129	525	5	Native copper in veinstone, containing flesh-colored weak quartz ore	do.
130	578	6	Mass of native copper coated with red oxide	do.
131	331	3	Native copper in veinstone	Northwest corner of Stautenbury vein
132	332	3	Do............do.	do.
133	333	3	Native copper coated with carbonate copper	do.
134	334	3	Native copper and silver in veinstone, with calc. spar	do.
135	335	3	Do...........do.......do.............do.	do.
136	336	3	Do...........do.......do.............do.	do.
137	371	3	Native copper in veinstone	do.
138	372	3	Do...........do.	do.
139	507	5	Native copper in phrenite. The surface of copper impressed by phrenite	do.
140	348	3	Native copper in veinstone	Northwest corner of Hogan's vein
141	349	3	Do...........do.	do.
142	350	3	Do...........do.	do.
143	351	3	Native copper and silver, with yellow calc. spar	do.
144	352	3	Do...........do..............do.	do.
145	353	3	Native copper and silver	Northwest corner of Kelley's vein

Catalogue of rocks, minerals, and ores, collected by Dr. C. T. Jackson.—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
146	354	3	Native copper in veinstone	Northwest corner of Kelley's vein
147	355	3	Native copper with phrenite	do.
148	359	3	Native copper in calc. spar	Northwest corner of Middle vein
149	378	3	Native copper in phrenite	do.
150	379	3	Native copper in calc. spar	do.
151	360	3	Do. do.	Northwest corner of East vein
152	361	3	Do. do.	do.
153	373	3	Native copper in veinstone	do.
154	374	3	Do. do.	do.
155	375	3	Native copper in veinstone, with red oxide	do.
156	376	3	Do. do.	Northwest corner of West vein
157	377	3	Do. do.	do.
158	508	5	Indian stone-hammer	Northwest corner of Old Indian mine
159	509	5	Do. do.	do.
160	510	5	Do. do.	do.
161	511	5	Do. do.	do.
162	325	3	Light green calcareous veinstone, containing native copper	Copper Falls
163	326	3	Do. do. do. do. do.	do.
164	327	3	Arborescent copper and red feldspar	do.
165	328	3	Native copper and silver, with leonhardite	do.
166	329	3	Leonhardite and calc. spar	do.
167	330	3	Red analcime	do.
168	478	4	Do.	do.
169	479	4	Red analcime radiated	do.
170	480	4	Red analcime, cal. spar, and red feldspar	do.
171	481	4	Native copper in laumonite passing into red analcime	do.
172	482	4	Native copper, calc. spar, and red feldspar	do.
173	535	5	Do. do. do.	do.
174	536	5	Cal. spar. and red feldspar	do.
175	537	5	Arborescent copper	do.
176	538	5	Arborescent copper coated with green carbonate of copper	do.
177	654	7	Native copper in veinstone with analcime	do.
178	655	7	Native copper in veinstone, containing chlorite with analcime and calc. spar	do.

179	656	7	Native copper in veinstone, containing calc. spar with analcime and calc. spar	do.
180	657	7	Native copper in veinstone, containing chlorite with red analcime	do.
181	658	7	Analcime and red feldspar in trap containing chlorite	do.
182	659	7	Do. do. do.	do.
183	660	7	Analcime	do.
184	661	7	Crystallized native copper and fine crystals of analcime	do.
185	662	7	Analcime	do.
186	663	7	Analcime and native copper	do.
187	664	7	Vein of red and white analcime and calc. spar in trap, containing chlorite	do.
188	665	7	Crystals of analcime and calc. spar, with red feldspar—arborescent	do.
189	666	7	Red analcime in trap, containing chlorite	do.
190	667	7	Red analcime and mesotype	do.
191	668	7	Red analcime and calc. spar	do.
192	672	7	Native copper in light colored veinstone, containing phrenite and carb. lime	do.
193	673	7	Do. do. do. do.	do.
194	674	7	Do. do. do. do.	do.
195	675	7	Red analcime in light colored veinstone, containing carb. of lime	do.
196	676	7	Native copper in veinstone, containing phrenite and calc. spar	do.
197	677	7	Do. do. do. do.	do.
198	678	7	Do. do.	do.
199	679	7	Native copper in veinstone, containing calc. spar	do.
200	680	7	Native copper in veinstone, containing calc. spar and green earth	Copper Falls.
201	681	7	Native copper in veinstone, containing green earth	do.
202	682	7	Phrenite, analcime, and calc. spar	do.
203	683	7	Native copper in phrenite	do.
204	684	7	Native copper and silver in calc. spar, with leonhardite and green earth	do.
205	685	7	Do. do. do. do.	do.
206	686	7	Do. do. do. do.	do.
207	687	7	Do. do. do. do.	do.
208	688	7	Do. do. do. do.	do.
209	689	7	Red feldspar and arborescent copper in trap, containing chlorite	do.
210	690	7	Trap resembling scoria, containing red feldspar and crystals of native copper and calc. spar	Copper Falls (bottom of mine)
211	691	7	Do. do. do. do.	do.
212	692	7	Do. do. do. do.	do.
213	693	7	Native copper in calc. spar and leonhardite	do.
214	694	7	Do. do.	do.
215	695	7	Do. do.	do.
216	696	7	Do. do.	do.
217	697	7	Native copper, showing the form and angles of calc. spar	do.
218	698	7	Arborescent copper	do.

Catalogue of rocks, minerals, and ores, collected by Dr. C. T. Jackson—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
219	699	7	Arborescent copper	Copper Falls
220	700	7	Do.	do.
221	701	7	Leonhardise and calc. spar	do.
222	702	7	Do. do.	do.
223	703	7	Do. do.	do.
224	704	7	Do. do.	do.
225	705	7	Do. do.	do.
226	706	7	Do. do.	do.
227	707	7	Do. do.	do.
228	708	7	Do. do.	do.
229	740	8	Crystallized native copper and red feldspar on amygdaloid	do.
230	741	8	Arborescent copper in calc. spar, with red feldspar	do.
231	742	8	Native silver with calc. spar	do.
232	743	8	Mass of native copper in laumonite	do.
233	744	8	Crystals of native copper and calc. spar—modifications of the scalene dodecahedron	do.
234	1024	10	Arborescent copper (good specimen)	do.
235	1025	10	Do. do.	do.
236	1026	10	Mass of knotty, contorted native copper, showing large crystals of native copper	do.
237	669	7	Fine compact brown sandstone	Above Copper Falls
238	670	7	Do. do.	do.
239	671	7	Do. do.	do.
240	337	3	Native copper in veinstone	Northwestern Company—Slawson's vein
241	338	3	Do. do.	do.
242	339	3	Do. do.	do.
243	340	3	Do. do.	do.
244	341	3	Do. do.	do.
245	342	3	Do. do.	do.
246	369	3	Native copper in veinstone (dark-colored trappose)	do.
247	370	3	Do. do. do.	do.
248	500	5	Do. do. do.	do.
249	501	5	Native copper in veinstone, light green trappose	do.

250	502	5	Native copper in veinstone, dark-colored trappose	do.
251	503	5	Native copper in dark-colored veinstone	do.
252	504	5	Native copper in light green veinstone	do.
253	505	5	Native copper in light green veinstone, (from 2d shaft, 7 feet from surface)	do.
254	506	5	Native copper in veinstone with laumonite	do.
255	811	8	Mass of native copper in epidote	Northwestern Company, lease 8
256	812	8	Native copper in veinstone with bluish green earth and calc. spar	do.
257	343	3	Black sulphuret of copper in veinstone	Michigan Company
258	344	3	Do. do.	do.
259	345	3	Do. do.	do.
260	346	3	Do. do.	do.
261	347	3	Do. do.	do.
262	366	3	Black sulphuret of copper	do.
263	367	3	Do.	do.
264	368	3	Do.	do.
265	356	3	Amygdaloid containing native copper and silver	Eagle river.
266	357	3	Do. do.	do.
267	358	3	Do. do.	do.
268	362	3	Red feldspar in trap	do.
269	380	3	Tabular spar	do.
270	381	3	Do.	do.
271	382	3	Boulders of native copper	do.
272	383	3	Red feldspar and prehnite	do.
273	384	3	Do. do.	do.
274	385	3	Do. do.	do.
275	386	3	Do. do.	do.
276	387	4	Liemise rock	do.
277	388	4	Do.	do.
278	389	4	Greenstone	do.
279	390	4	Do.	do.
280	391	4	Feldspar and chlorite	do.
281	392	4	Do. do.	do.
282	393	4	Red feldspar, analcime, and prehnite in amygdaloid, containing chlorite	do.
283	394	4	Do. do. do.	do.
284	395	4	Do. do.	do.
285	396	4	Do. do.	do.
286	397	4	Do. do.	do.
287	398	4	Red feldspar and crystals of calc. spar more obtuse than primary	do.
288	399	4	Red feldspar, analcime prehnite, coated with light green chlorite	do.
289	400	4	Red feldspar, calc. spar, and analcime prehnite, coated with light green chlorite	do.
290	401	4	Pebble of prehnite and red feldspar	do.

Catalogue of rocks, minerals, and ores, collected by Dr. C. T. Jackson—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
291	402	4	Native copper in phrenite	Eagle river.
292	403	4	Native copper impressed by phrenite	do.
293	404	4	Red feldspar on trap containing nodules of chlorite	do.
294	405	4	Do. do. do.	do.
295	406	4	Red feldspar and datholite in dark green trap	do.
296	407	4	Red feldspar and massive datholite, coated with minute crystals of the same	do.
297	408	4	Amygdaloid containing red feldspar and phrenite	do.
298	409	4	Do. do.	do.
299	410	4	Amygdaloid containing red feldspar, native copper, and calc. spar	do.
300	621	6	Amygdaloid containing native silver and native copper	do.
301	622	6	Do. do.	do.
302	623	6	Amygdaloid containing native silver and copper	do.
303	624	6	Do. do.	do.
304	625	6	Amygdaloid containing native silver and copper with epidote	do.
305	626	6	Crystals of native copper and quartz in trap containing chlorite	do.
306	627	6	Native copper (fragments from mining heap)	do.
307	628	6	Do. do.	do.
308	724	8	Native copper in dark-colored amygdaloid containing quartz	do.
309	725	8	Do. do. do.	do.
310	726	8	Do. do. do.	do.
311	727	8	Native silver and copper in dark colored amygdaloid containing quartz	do.
312	728	8	Do. do. do.	do.
313	729	8	Do. do. do.	do.
314	730	8	Do. do. do.	do.
315	731	8	Do. do. do.	do.
316	746	8	Indian hammer	Eagle river, west vein.
317	747	8	Do.	do.
318	748	8	Hone slate, light, soft variety, shewing stratification	do.
319	749	8	Do. do.	do.
320	750	8	Do. do.	do.
321	977	10	Native copper in veinstone, old Lake Superior cabinet?	Eagle river, vein in pit 3, May 28, 1847.
322	978	10	Native copper with calc. spar, old Lake Superior cabinet?	Eagle river, opening S. drift, Nov. 1846.
323	979	10	Native copper with leonhardite, old Lake Superior cabinet?	Eagle river vein, pit 3, May 28, 1847.

324	980	10	Native copper, old Lake Superior cabinet	Eagle river, Winn B, 40 feet deep, Sept., 1846.
325	981	10	Native copper in calc. spar, old Lake Superior cabinet	Eagle river, Winn B, 173 feet deep, Nov. 25, 1846
326	982	10	Native copper in dark red trap, thin sheets, old Lake Superior cabinet	Eagle river, Winn B, 1846
327	983	10	Native copper in dark red trap, thin sheets and masses, old Lake Superior cabinet	Eagle river, Drift No. 1, Irish contract
328	984	10	Native copper in dark green trap, coated with chlorite	Eagle river
329	985	10	Native copper in amygdaloid, containing chlorite phrenite, the copper impressed by prehnite	do
330	986	10	Native copper in amygdaloid containing chlorite phrenite, the copper impressed by phrenite	do
331	987	10	Gray sulphuret of copper, with calc. spar and decomposed green earth, old Lake Superior cabinet	Eagle river, Winn B, 60 feet deep, from drift 1
332	988	10	Native silver and copper in trappose veinstone, containing chlorite	do
333	989	10	Native copper, impressed by quartz	Eagle river, pit No. 2
334	990	10	Native copper in amygdaloid, perfect amygdules of native copper	Eagle river, west side of vein
335	991	10	Do. do.	do
336	992	10	Mass of native copper, found near the Indian stone hammers	do
337	995	10	Boulders of iron pyrites	Eagle river diggings
338	364	3	Amygdaloid, with agates	Fort Wilkins
339	365	3	Do.	do
340	589	6	Compact trap	do
341	594	6	Amygdaloid, containing chalcedony and quartz	do
342	595	6	Amygdaloid, containing agates and geodes of quartz	do
343	483	4	Green and blue silicate of copper	Pittsburg & Boston company
344	484	4	Do.	do
345	485	4	Do.	do
346	486	4	Do.	do
347	487	4	Do.	do
348	488	4	Do.	do
349	489	4	Do.	do
350	490	5	Black oxide of manganese	do
351	491	5	Black oxide of manganese, compact and massive	do
352	492	5	Black oxide of manganese, slicken-sides	do
353	493	5	Black oxide of manganese, compact and massive	do
354	494	5	Do. do.	do
355	495	5	Black oxide of manganese, with quartz and calc. spar	do
356	496	5	Do. do.	do
357	497	5	Do. do.	do

Catalogue of rocks, minerals, and ores, collected by Dr. C. T. Jackson—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
358	498	5	Black oxide of manganese, with quartz and calc. spar	Pittsburg & Boston company
359	499	5	Black oxide of manganese, with calc. spar	do.
360	528	5	Massive calc. spar	do.
361	532	5	Do.	do.
362	533	5	Do.	do.
363	604	6	Trap joining sandstone, glazed and striated	do.
364	605	6	Do. do.	do.
365	607	6	Rock colored by green carbonate of copper	Pittsburg & Boston company, southeast corner view, upper drift
366	608	6	Do. do.	do.
367	609	6	Dark green trap	Pittsburg & Boston company, southeast corner end of drift four
368	610	6	Do.	do.
369	611	6	Trap containing chlorite	Pittsburg & Boston company, from trail 1¾ miles from southeast corner
370	612	6	Dark brown crystalline trap	Pittsburg & Boston company, southeast corner, top of hill, No. 6
371	613	6	Do.	Pittsburg & Boston company, southeast corner, bottom of hill, No. 1
372	614	6	Dark brown trap, containing chlorite	Pittsburg & Boston company, southeast corner, mouth of drift, No. 3
373	615	6	Rocks containing vein of carbonate of lime	Pittsburg & Boston company, southeast corner, lower drift
374	941	9	Compact dark trap, stecken sides	do.
375	950	9	Dark green compact trap (no trace of crystallization)	Pittsburg & Boston company, southeast corner, No. 5
376	951	9	Light gray trap, containing chlorite	do.
377	952	9	Vein of quartz and calc. spar in dark red trap, containing chlorite	Pittsburg & Boston company, southeast corner, lower drift
378	953	9	Trap containing chlorite	Pittsburg & Boston company, from southeast corner 1¾ miles
379	968	10	Dark green crystalline trap, feldspar, and hornblende	Pittsburg & Boston company, south of Copper Hill, south side of hill

380	969	10	Dark green crystalline trap, not so crystalline as the preceding	Pittsburg & Boston company, vein wall, near summit of hill
381	970	10	Do.............do	do
382	971	10	Rock consisting of red feldspar speckled with chlorite	Pittsburg & Boston company, south of Copper Hill, south side of hill
383	591	6	Altered sandstone, contorted	Copper harbor
384	601	6	Altered sandstone from the conglomerate on	Hay's point, Copper harbor
385	919	9	Altered red slate with grey bands, furrowed and contorted	do
386	920	9	Do.............do	do
387	921	9	Do.............do	do
388	922	9	Do.............do	do
389	923	9	Do.............do	do
390	908	9	Amygdaloidal trap, amygdules of chlorite, calc. spar, and red leonhardite	Point west of Porter's island, Copper harbor.
391	909	9	Do.............do	do
392	910	9	Do.............do	do
393	911	9	Do.............do	do
394	912	9	Do.............do	do
395	913	9	Do.............do	do
396	914	9	Do.............do	do
397	915	9	Do.............do	do
398	916	9	Do.............do	do
399	917	9	Do.............do	do
400	918	9	Do.............do	do
401	411	4	Laumonite and calc. spar	Cliff mine
402	412	4	Native copper coated with black oxide in veinstone with quartz	do
403	413	4	Native copper in veinstone with drusy tabular reticulated quartz	do
404	1017	10	Native copper and silver in epidote rock (old Lake Superior cabinet?)	Cliff mine drift of adit. view four feet
405	1016	10	Native silver (large pieces) and native copper in veinstone (calc. spar and green earth)	do
406	1018	10	Mass of native copper impressed by quartz crystals, with calc. spar	do
407	1019	10	Native silver piercing large sheet of native copper (junction of silver and copper)	do
408	1020	10	Arborescent copper and dodecahedral crystals of native copper	do
409	1021	10	Drusy tabular reticulated quartz crystals of copper and silver	do
410	1022	10	Drusy tabular reticulated quartz and crystals of copper	do
411	1023	10	Drusy tabular reticulated quartz and modified rhombohedrons of calc. spar	do
412	1027	10	Native copper and fibrous crystals of red oxide	do
413	1029	10	Sample of clipping mortised out in dividing large masses of copper	do
414	428	4	Jasper	Jasper point
415	429	4	Do	do
416	414	4	Breccia of white and green slate	Near Jasper point

Catalogue of rocks, minerals, and ores, collected by Dr. C. T. Jackson—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
417	415	4	Breccia of white and green slate	Near Jasper point
418	416	4	Do.........do......do	do
419	432	4	Porphyritic trap	do
420	433	4	Do.....do	do
421	417	4	Scoria from fusion of trap and sandstone, (small round pebbles,)	Boston location
422	418	4	Do..........do..........do	do
423	419	4	Do..........do..........do	do
424	420	4	Altered slate	do
425	430	4	Junction of trap and sandstone	Bête Gris
426	431	4	Do.........do	do
427	434	4	Dark colored trap	do
428	435	4	Vesicular trap	do
429	436	4	Spotted trap, with chlorite in external cavity	do
430	437	4	Amygdaloidal trap	do
431	438	4	Porphyritic trap, containing a vein of calc. spar	do
432	439	4	Calc. spar, containing veins of red feldspar	do
433	440	4	Columnar trap	do
434	441	4	Do....do	do
435	442	4	Vesicular trap	do
436	443	4	Trap, containing veins of calc. spar	do
437	444	6	Trap, containing chlorite	do
438	586	6	Jasper	do
439	967	10	Grey sandstone, fine-grained	Bête Gris bog
440	421	4	Red and grey sandstone	Point south of Bête Gris
441	422	4	Red and grey sandstone, with interlayers of red chalk	do
442	423	4	Grey sandstone, containing spheroids of red chalk surrounded by a ring of white slate	do
443	427	4	White sandstone	do
444	424	4	Red and grey sandstone	Keweenaw bay
445	425	4	Do.........do	do
446	426	4	Red sandstone	do
447	837	9	Hone slate, grey, soft	L'Anse
448	838	9	Do........do	do

449	839	9	Do.......do	do
450	840	9	Do.......do	do
451	841	9	Do.......do	do
452	842	9	Red and green slate contorted, surface polished and grooved, containing scattered crystals of pseudomorphs of iron pyrites replaced by carb. of lime	do
453	843	9	Red and green slate contorted, surface polished and grooved, containing scattered crystals of pseudomorphs of iron pyrites replaced by carb. of lime	do
454	844	9	Red and green slate, contorted, surface polished	do
455	845	9	Red slate	do
456	846	9	Do	do
457	847	9	Do	do
458	848	9	Red slate, breaks in splintery fragments	do
459	849	9	Red slate, with light green slate, surface polished and grooved	do
460	850	9	Red slate, containing crystals of pseudomorphous pyrites replaced by carb. of lime, surface polished	do
461	851	9	Red slate, breaks splintery on surface	do
462	852	9	Boulder of red sandstone, with nodules of grey sandstone and black speck in centre	
463	853	9	Red sandstone, with nodules of grey sandstone and black speck in centre	do
464	854	9	Do.......do.......do.......do.......do	do
465	855	9	Red and grey sandstone	do
466	856	9	Altered sandstone, green, compact	do
467	857	9	Do.......do	do
468	858	9	Do.......do	do
469	859	9	Altered sandstone, containing a vein of quartz, coarse-grained, green	do
470	860	9	Do.......do.......do.......do.......do	do
471	861	9	Altered sandstone, coarse-grained, green	do
472	862	9	Do.......do.......do	do
473	954	10	Jasper, formed from sandstone	do
474	955	10	Do.......do	58, 28, 30, near Bare rock
475	956	10	Do.......do	do
476	957	10	Do.......do	do
477	958	10	Do.......do	do
478	959	10	Do.......do	do
479	960	10	Grey sandstone	do
480	961	10	Do	do
481	962	10	Red sandstone	do
482	963	10	Alternated red and grey sandstone	do
483	964	10	Breccia joined with chlorite	58, 28, 29, and 30, near Bare rock
484	965	10	Do.......do	58, 28, 29, and 30, near Bare rock (near sketch).
485	966	10	Chlorite. This appears to be an indurated slate, green-coated chlorite joined with breccia	58, 28, 29, and 30, near Bare rock

Catalogue of rocks, minerals, and ores, collected by Dr. C. **T. Jackson**—Continued.

No.	No.		Description.	Locality.
[illegible]	[illegible]	[illegible]	Breccia of white and green slate	Near Jasper point
[illegible]	[illegible]	[illegible]	Do......do......do.	do.
[illegible]	[illegible]	[illegible]	[illegible] trap	do.
[illegible]	[illegible]	[illegible]	[illegible]	do.
[illegible]	[illegible]	[illegible]	[illegible] trap and sandstone, (small round pebbles,)	Boston location
[illegible]	[illegible]	[illegible]	do.	do.
[illegible]	[illegible]	[illegible]	do.	do.
[illegible]	[illegible]	[illegible]	[illegible]	do.
[illegible]	[illegible]	[illegible]	[illegible]	Bête Gris
[illegible]	[illegible]	[illegible]	[illegible]	do.
[illegible]	[illegible]	[illegible]	Do.	do.
[illegible]	[illegible]	[illegible]	[illegible] trap	do.
[illegible]	[illegible]	[illegible]	[illegible] trap	do.
[illegible]	[illegible]	[illegible]	[illegible], with chlorite in external [illegible]	do.
[illegible]	[illegible]	[illegible]	[illegible]	do.
[illegible]	[illegible]	[illegible]	[illegible] containing a vein of calc. spar	do.
[illegible]	[illegible]	[illegible]	[illegible] veins of red feldspar	do.
[illegible]	[illegible]	[illegible]	[illegible]	do.
[illegible]	[illegible]	[illegible]	[illegible]	do.
[illegible]	[illegible]	[illegible]	[illegible]	do.
[illegible]	[illegible]	[illegible]	[illegible]	do.
[illegible]	[illegible]	[illegible]	[illegible]	do.
[illegible]	[illegible]	[illegible]	[illegible]	Bête Gris bog
[illegible]	[illegible]	[illegible]	[illegible]	Point south of Bête Gris
[illegible]	[illegible]	[illegible]	[illegible] chalk	do.
439	[illegible]	[illegible]	[illegible], with [illegible] chalk surrounded by a ring of [illegible]	do.
440	[illegible]	[illegible]	[illegible] spheru[illegible]	do.
[illegible]	492	[illegible]	[illegible]	Keweenaw bay
[illegible]	493	[illegible]	[illegible]	do.
[illegible]	497	4	R[illegible]	do.
[illegible]	494	4	Do.	L'Anse
[illegible]	495	4	Red sand[illegible]	do.
[illegible]	496	4	[illegible]	
[illegible]	837	9	Hone slate, [illegible]	
[illegible]	838	9	Do.	

[illegible]	840	9	[illegible]	do.
[illegible]	841	9	I [illegible]	do.
[illegible]52	842	9	Red a[illegible] nd grooved, containing scattered crys[illegible]phs of ir[illegible]es replaced by carb. of lime	do.
453	843	9	Red and green slate c[illegible], surface polished and grooved, containing scattered crystals of pseudomorphs of iron pyrites replaced by carb. of lime	do.
454	844	9	Red and green slate, contorted, surface polished	do.
455	845	9	Red slate	do.
456	846	9	Do.	do.
457	847	9	Do.	do.
458	848	9	Red slate, breaks in splintery fragments	do.
459	849	9	Red slate, with light green slate, surface polished and grooved	do.
460	850	9	Red slate, containing crystals of pseudomorphous pyrites replaced by carb. of lime, surface polished	do.
461	851	9	Red slate, breaks splintery on surface	do.
462	852	9	Boulder of red sandstone, with nodules of grey sandstone and black speck in centre	
463	853	9	Red sandstone, with nodules of grey sandstone and black speck in centre	do.
464	854	9	Do. do. do. do. do.	do.
465	855	9	Red and grey sandstone	do.
466	856	9	Altered sandstone, green, compact	do.
467	857	9	Do. do.	do.
468	858	9	Do. do.	do.
469	859	9	Altered sandstone, containing a vein of quartz, coarse-grained, green	do.
470	860	9	Do. do. do. do. do.	do.
471	861	9	Altered sandstone, coarse-grained, green	do.
472	862	9	Do. do. do.	do.
473	954	10	Jasper, formed from sandstone	do.
474	955	10	Do. do.	58, 28, 30, near Bare rock
475	956	10	Do. do.	do.
476	957	10	Do. do.	do.
477	958	10	Do. do.	do.
478	959	10	Do. do.	do.
479	960	10	Grey sandstone	do.
480	961	10	Do.	do.
481	962	10	Red sandstone	do.
482	963	10	Alternated red and grey sandstone	do.
483	964	10	Breccia joined with chlorite	58, 28, 29, and 30, near Bare rock
484	965	10	Do. do.	58, 28, 29, and 30, near Bare rock (near sketch).
485	966	10	Chlorite. This appears to be an indurated slate, green-coated chlorite joined with breccia	58, 28, 29, and 30, near Bare rock

Catalogue of rocks, minerals, and ores, collected by Dr. C. T. Jackson—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
417	415	4	Breccia of white and green slate	Near Jasper point
418	416	4	Do.........do.....do	do
419	432	4	Porphyritic trap	do
420	433	4	Do.....do	do
421	417	4	Scoria from fusion of trap and sandstone, (small round pebbles,)	Boston location
422	418	4	Do..................do.................do	do
423	419	4	Do..................do.................do	do
424	420	4	Altered slate	do
425	430	4	Junction of trap and sandstone	Bête Gris
426	431	4	Do.........do	do
427	434	4	Dark colored trap	do
428	435	4	Vesicular trap	do
429	436	4	Spotted trap, with chlorite in external cavity	do
430	437	4	Amygdaloidal trap	do
431	438	4	Porphyritic trap, containing a vein of calc. spar	do
432	439	4	Calc. spar, containing veins of red feldspar	do
433	440	4	Columnar trap	do
434	441	4	Do....do	do
435	442	4	Vesicular trap	do
436	443	4	Trap, containing veins of calc. spar	do
437	444	6	Trap, containing chlorite	do
438	586	6	Jasper	do
439	967	10	Grey sandstone, fine-grained	Bête Gris bog
440	421	4	Red and grey sandstone	Point south of Bête Gris
441	422	4	Red and grey sandstone, with interlayers of red chalk	do
442	423	4	Grey sandstone, containing spheroids of red chalk surrounded by a ring of white slate	do
443	427	4	White sandstone	do
444	424	4	Red and grey sandstone	Keweenaw bay
445	425	4	Do.........do	do
446	426	4	Red sandstone	do
447	837	9	Hone slate, grey, soft	L'Anse
448	838	9	Do.......do	do

449	839	9	Do.......do	do
450	840	9	Do.......do	do
451	841	9	Do.......do	do
452	842	9	Red and green slate contorted, surface polished and grooved, containing scattered crystals of pseudomorphs of iron pyrites replaced by carb. of lime	do
453	843	9	Red and green slate contorted, surface polished and grooved, containing scattered crystals of pseudomorphs of iron pyrites replaced by carb. of lime	do
454	844	9	Red and green slate, contorted, surface polished	do
455	845	9	Red slate	do
456	846	9	Do	do
457	847	9	Do	do
458	848	9	Red slate, breaks in splintery fragments	do
459	849	9	Red slate, with light green slate, surface polished and grooved	do
460	850	9	Red slate, containing crystals of pseudomorphous pyrites replaced by carb. of lime, surface polished	do
461	851	9	Red slate, breaks splintery on surface	do
462	852	9	Boulder of red sandstone, with nodules of grey sandstone and black speck in centre	
463	853	9	Red sandstone, with nodules of grey sandstone and black speck in centre	do
464	854	9	Do.............do...........do...........do.......do	do
465	855	9	Red and grey sandstone	do
466	856	9	Altered sandstone, green, compact	do
467	857	9	Do.............do	do
468	858	9	Do.............do	do
469	859	9	Altered sandstone, containing a vein of quartz, coarse-grained, green	do
470	860	9	Do. ....do...........do...........do.......do	do
471	861	9	Altered sandstone, coarse-grained, green	do
472	862	9	Do.............do.........do	do
473	954	10	Jasper, formed from sandstone	do
474	955	10	Do.............do	58, 28, 30, near Bare rock
475	956	10	Do.............do	do
476	957	10	Do.............do	do
477	958	10	Do.............do	do
478	959	10	Do.............do	do
479	960	10	Grey sandstone	do
480	961	10	Do	do
481	962	10	Red sandstone	do
482	963	10	Alternated red and grey sandstone	do
483	964	10	Breccia joined with chlorite	58, 28, 29, and 30, near Bare rock
484	965	10	Do...........do	58, 28, 29, and 30, near Bare rock (near sketch).
485	966	10	Chlorite. This appears to be an indurated slate, green-coated chlorite joined with breccia	58, 28, 29, and 30, near Bare rock

Catalogue of rocks, minerals, and ores, collected by Dr. C. T. Jackson—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
486	445	4	Native copper	Quincy Mining Company
487	446	4	Do	do
488	447	4	Do	do
489	448	4	Native copper, in veinstone	do
490	449	4	Do ... do	do
491	450	4	Native copper, in veinstone, containing prehnite	do
492	451	4	Native silver and copper in veinstone, containing compact green earth	do
493	452	4	Do ... do ... do ... do ... do ... do	do
494	453	4	Native silver and copper in amygdaloid trap, containing chlorite	do
495	454	4	Do ... do ... do ... do ... do	do
496	455	4	Do ... do ... do ... do ... do	do
497	456	4	Native copper in amygdaloidal trap	do
498	457	4	Native copper in hard light green veinstone	do
499	458	4	Porphyritic trap	do
500	459	4	Amygdaloidal trap, containing red feldspar and chlorite	do
501	632	6	Native silver and copper in dark brown trap, with quartz, phrenite and green earth	do
502	633	6	Native copper in trap, with calc. spar and phrenite	do
503	634	6	Native copper in veinstone with calc. spar	do
504	635	6	Mass of native copper	do
505	636	6	Native copper in veinstone containing epidote	do
506	637	6	Do ... do ... do	Quincy Mining Company
507	638	6	Native copper in trap containing quartz, phrenite, and green earth	do
508	639	6	Do ... do ... do ... do	do
509	640	6	Native copper in dark brown trap, containing epidote trap very compact	do
510	641	6	Native copper in light green veinstone	do
511	642	6	Native copper in dark brown trap, showing slicken-sides	do
512	460	4	Native copper	North American Company
513	461	4	Native copper in veinstone	do
514	462	4	Native copper in veinstone, with calc. spar	North American Company, N. C. qr. sec 3.
515	463	4	Do ... do ... do	do
516	464	4	Do ... do ... do	do
517	465	4	Native silver and copper in veinstone, containing green earth	do

518	467	4	Native copper in veinstone, with carbonate of copper	do
519	468	4	Apophyllite and calc. spar	do
520	469	4	Do. do	do
521	469	4	Do. do	do
522	470	4	Do. do	do
523	471	4	Agate and yellow jasper	do
524	652	6	Dark green compact trap, coated with fibrous chlorite, resembling talc	do
525	751	8	Apophyllite and calc. spar	do
526	752	8	Do. do	do
527	753	8	Do. do	do
528	754	8	Do. do	do
529	755	8	Do. do	do
530	756	8	Apophyllite and calc. spar (acute rhombohedrons)	do
531	757	8	Apophyllite and calc. spar	North American Company, qr. sec 2
532	758	8	Calc. spar acute rhombohedrons	North American Company
533	759	8	Do. do	do
534	760	8	Do. do	North American Company, qr. sec. 2
535	761	8	Native copper in veinstone, containing calc. spar and green earth	North American Company
536	762	8	Native copper in veinstone, containing quartzose	do
537	763	8	Native copper in veinstone, containing calc. spar	do
538	764	8	Native silver and copper in veinstone, containing green earth	North American Company, qr. sec. 2
539	765	8	Native copper in dark green veinstone, containing quartz	do do
540	766	8	Native copper in veinstone, composed principally of green earth	do do
541	772	8	Native copper from bottom of mine, where the vein takes a steeper dip	North American Company
542	863	8	Calc. spar—curved faces, modifications of rhomboid more obtuse than primary (ac. 79.45, ob. 100.15—180.00)	do
543	864	9	Do. do do do	do
544	865	9	Do. do do do	do
545	866	9	Do. do do do	do
546	867	9	Calc. spar—curved faces, modifications of rhomboid more obtuse than primary; surface of crystals frosted with small crystals	do
547	868	9	Calc. spar—curved faces, modifications of rhomboid more obtuse than primary	do
548	869	9	Do. do do do	do
549	870	9	Calc. spar and laumonite	do
550	871	9	Rhombohedron of calc. spar with laumonite	do
551	872	9	Crystallized native copper, and native copper in calc. spar	do
552	873	9	Crystals of native copper in calc. spar—octahedron edges replaced, passing to dodecahedron	do
553	874	9	Acute rhombohedrons of calc. spar, containing native copper	do
554	875	9	Mass of native copper impressed by quartz crystals	do

Catalogue of rocks, minerals, and ores, collected during the years 1847 *and* 1848—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
555	876	9	Mass of native copper impressed by quartz crystals	North American Company
556	877	9	Native copper, coated with green carbonate	do
557	888	9	Mass of native copper impressed by quartz crystals	North American Mine
558	889	9	Native copper in veinstone, containing calc. spar	do
559	890	9	Native copper in green veinstone, impressed by quartz crystals	do
560	891	9	Do do do	do
561	892	9	Native copper in veinstone, containing chlorite	do
562	893	9	Native copper in dark red veinstone, with apophyllite and calc. spar	do
563	894	9	Native copper in veinstone, containing epidote, with apophyllite and calc. spar	do
564	895	9	Dodecahedral crystals of copper in dark red veinstone, frosted with minute crystals of apophyllite	do
565	896	9	Native copper and silver	do
566	897	9	Do do	do
567	898	9	Native copper in veinstone, with drusy, tabular, reticulated quartz	do
568	899	9	Crystals of native copper, with drusy, tabular, reticulated quartz	do
569	993	10	Native copper in veinstone, coated with red oxide—old Lake Superior cabinet	North American Mine, vein No. 1, July, '47.
570	994	10	Native copper in vein of prehnite and calc. spar, with red oxide and green carbonate—old Lake Superior cabinet	North American Mine, new vein, Jan., '47.
571	475	4	Native copper in veinstone; a light, jaspery rock, resembling marbling from veins of trap intersecting	Boston and Lake Superior Company
572	476	4	Do do do do	do
573	477	4	Amygdaloid with prehnite	do
574	938	9	Native copper in vein of calc. spar in veinstone, containing green earth and chlorite	do
575	939	9	Do do do do	do
576	940	9	Do do do do	do
577	943	9	Pebble of altered sandstone (jasper) shaped like the head of an encrinite	Boston and Lake Superior Company, on lake shore.
578	539	5	Gray sulphuret of copper	Bohemian Mine, shaft No. 1
579	540	5	Do do	do do
580	541	5	Do do	Bohemian Mine, shaft No. 1, upper drift
581	542	5	Gray sulphuret of copper (working ore on bank)	Bohemian Mine, shaft No. 1, north drift
[illegible]	543	5	Peacock ore	do do do

583	544	5	Gray sulphuret of copper	Bohemian Mine, E. and W. view
584	545	5	Do	Bohemian mine, shaft No. 1
585	546	5	Do	Bohemian mine, shaft No. 2
586	547	5	Gray sulphuret of copper with calc. spar	do
587	548	5	Gray sulphuret of copper from new opening 200 feet from top of mountain	Bohemian mine
588	549	5	Do ... do	do
589	550	5	Do ... do	do
590	551	5	Do ... do	do
591	552	5	Gray sulphuret of copper with calc. spar	Bohemian mine, SE. and W. vein
592	553	5	Copper pyrites	do
593	554	5	Red feldspar rock containing chlorite	Bohemian mine, near 1st shaft
594	555	5	Red feldspar with trace of copper pyrites	Bohemian mine, No. 2 shaft
595	556	5	Specular iron and green carb. copper in trap	Bohemian mine
596	557	5	Do ... do	do
597	558	5	Copper pyrites	Lac la Belle Co., E. and W. vein
598	559	5	Gray sulphuret of copper	do
599	560	5	Do	do
600	561	5	Do	do
601	562	5	Copper pyrites	do
602	563	5	Copper pyrites from working ore on bank	Lac la Belle Co., shaft No. 1, north drift
603	564	5	Gray sulphuret of copper with calc. spar	do
604	565	5	Do ... do	Lac la Belle Co., vein No. 1, north drift
605	566	5	Do ... do	do
606	567	5	Gray sulphuret and green carb. of copper	Lac la Belle Co., shaft No. 2, north drift
607	568	5	Do ... do	Lac la Belle Co., Sibley's vein No. 2, N. drift
608	596	6	Trace of gray sulphuret of copper in rock composed of feldspar, carb. of lime, and chlorite	Lac la Belle adit
609	597	6	Do ... do ... do	do
610	598	6	Do ... do ... do	do
611	599	6	Rock containing a little gray sulphuret of copper	Lac la Belle Co., N. and S. vein
612	600	6	Gray sulphuret and green carb. copper	Lac la Belle Co., E. and W. vein
613	924	6	Gray sulphuret, coated, and green carb. copper	do
614	925	9	Serpentine and calc. spar, with a little gray sulphuret of copper	do
615	926	9	Gray sulphuret of copper in veinstone containing calc. spar	do
616	927	9	Do ... do	do
617	928	9	Gray sulphuret of copper in veinstone containing serpentine and calc. spar	Lac la Belle Co., N. and S. vein
618	929	9	Do ... do ... do	do
619	930	9	Do ... do ... do	Lac la Belle Co. adit
620	931	9	Gray sulphuret of copper in veinstone containing serpentine and calc. spar, and little laumonite	do
621	932	9	Do ... do ... do	do

Catalogue of rocks, minerals, and ores, collected during the years 1847 *and* 1848—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
622	933	9	Gray sulphuret of copper in veinstone containing serpentine and calc. spar, and little laumonite	Lac la Belle Co. adit
623	934	9	Light grayish green veinstone (serpentine and calc. spar) containing a little gray sulph. of copper	do.
624	935	9	Red slate with chlorite	do.
625	936	9	Trap consisting principally of feldspar and chlorite rock in confused masses	do.
626	937	9	Trap composed of feldspar, chlorite, and brown hornblende (?)	do.
627	587	6	Rock containing carb. lime, feldspar, chlorite, and epidote in which the ore is found	do.
628	569	5	Trap rock	Alliance Co., Lake Bluff
629	570	5	Trap containing specular iron with spots of epidote	do.
630	571	5	Trap containing a little gray sulphuret and green carb. copper	do.
631	572	5	Do. do.	do.
632	573	5	Trap containing a little gray sulphuret of copper	do.
633	574	5	Trap containing trace of gray sulphuret of copper with chlorite	do.
634	575	5	Gray sulphuret and green carb. copper	do.
635	579	6	Amygdaloid, amygdules of chlorite, near the conglomerate	do.
636	602	6	Calc. spar and prehnite	NW. cor. of loc. 17 on train for Lac la Belle.
637	603	6	Do.	do.
638	580	6	Cleaveable jasper	Mount Haughton
639	581	6	Do.	do.
640	582	6	Uncleaveable jasper near the trap	do.
641	583	6	Compact trap near the jasper	do.
642	616	6	Calc. spar, massive	Lake Shore Mining Co., W. the Portage.
643	617	6	Do.	do.
644	618	6	Do.	do.
645	619	6	Do.	do.
646	620	6	Amygdaloid containing laumonite	do.
647	643	6	Native copper in compact fine grained trap containing green earth	Eagle river, Sheffield and Nott's vein
648	644	6	Do. do. do.	do.
649	645	6	Native copper in compact fine grained trap containing calc. spar	do.
650	646	6	Native copper in compact fine grained trap containing green earth	do.
651	647	6	Native copper in compact fine grained trap containing calc. spar	do.

652	648	6	Native silver and copper in dark brown fine grained compact trap containing green earth	do
653	649	6	Light green veinstone, containing no copper, coated with quartz and prehnite, and showing slicken sides	do
654	650	6	Do. do. do	do
655	651	6	Do. do. do	do
656	745	8	Mass of native copper containing native silver	Forsyth Co's. mine.
657	813	8	Mass of native copper with red oxide and green carbonate	do
658	814	8	Do. do.	do
659	815	8	Do. do.	Forsyth Co.
660	816	8	Boulder of native copper found by Agendos	Forsyth Co. loc.
661	817	8	Native copper in epidote	do
662	818	8	Native copper in veinstone containing epidote and prehnite	do
663	819	8	Native copper in veinstone containing chlorite and quartz	do
664	820	8	Native copper in veinstone containing prehnite and quartz	do
665	821	8	Native copper in veinstone containing calc. spar, epidote, and chlorite	do
666	822	8	Native copper in veinstone containing calc. spar, quartz, and chlorite	do
667	767	8	Gray sulphuret of copper in porphyritic trap	Pray's lease 101
668	768	8	Do. do.	do
669	760	8	Do. do.	do
670	770	8	Do. do.	Praysville
671	771	8	Gray sulphuret of copper in veinstone containing calc. spar	do
672	790	8	Gray sulphuret of copper in porphyritic trap (bright red crystals of feldspar)	Pray's lease 101
673	791	8	Do. do. do	do
674	792	8	Do. do. do	do
675	793	8	Do. do. do	do
676	794	8	Do. do. do	do
677	795	8	Do. do. do	do
678	796	8	Do. do. do	do
679	797	8	Do. do. do	do
680	798	8	Do. do. do	do
681	799	8	Gray sulphuret of copper in porphyritic trap containing calc. spar	do
682	800	8	Do. do. do	do
683	801	8	Do. do. do	do
684	802	8	Do. do. do	do
685	803	8	Do. do. do	do
686	804	8	Do. do. do	Pray's lease 102
687	805	8	Do. do. do	do
688	806	8	Do. do. do	do
689	807	8	Do. do. do	do
690	1010	10	Porphyritic trap containing chlorite and prehnite	Pray's location.

Catalogue of rocks, minerals, and ores, collected during the years 1847 *and* 1848—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
691	1011	10	Gray sulphuret of copper in veinstone containing calc. spar	Pray's location
692	1012	10	Do. . . . do . . . . do	do
693	1013	10	Gray sulphuret of copper and green carb. in porphyritic trap	do
694	1014	10	Do. . . . do . . . . do	do
695	808	8	Iron containing a little copper	Pray's furnace
696	809	8	Black metal vesicular containing fibrous copper	do
697	810	8	Do. . . . do	do
698	472	4	Native copper in mass of calc. spar	58.32 S. W. ¼ sec. 36
699	773	8	Vein of native copper (thick) in prehnite	do . . . . do
700	774	8	Large mass of native copper from a vein coated with green carb	57.32 S. W. ¼ sec. 33
701	775	8	Native copper in epidote with calc. spar and prehnite	57.32 S. W. ¼ sec. 33
702	776	8	Native copper in epidote with calc. spar and chlorite	do . . . . do
703	777	8	Do. . . . do	do . . . . do
704	778	8	Native copper in epidote with chlorite	do . . . . do
705	779	8	Native copper in epidote with chlorite, calc. spar, prehnite, and laumonite	do . . . . do
706	780	8	Native copper in epidote with calc. spar and laumonite	do . . . . do
707	781	8	Massive prehnite in calc. spar	57.32 N. W. ¼ sec. 11
708	782	8	Do. . . . do	do . . . . do
709	783	8	Native copper in dark-green trap containing chlorite	do . . . . do
710	784	8	Native copper with calc. spar and soft, light-green earth	57.32 N. W. ¼ sec. 11
711	784	8	Native copper in dark-green trap containing chlorite	do . . . . do
712	786	8	Native copper in veinstone containing massive prehnite and calc. spar	do . . . . do
713	473	4	Calc. spar	do . . . . do
714	474	4	Calc. spar and prehnite	do . . . . do
715	787	8	Dark-green compact trap	Medora mine
716	828	8	Regulus light-gray crystalline fracture showing metallic copper	do
717	788	8	Gray sulphuret of copper and dark-green trap	Buffalo Company
718	789	8	Native copper in dark-green trap containing veins of quartz	do
719	823	8	Gray sulphuret of copper in dark-green veinstone containing chlorite	do
720	824	8	Do. . . . do . . . . do	do
721	825	8	Dark-red, smooth trap containing chlorite in scattered patches	Douglas Houghton mine
722	826	8	Veinstone containing prehnite and calc. spar (no copper)	do . . . . do
723	827	8	Do. . . . do . . . . do	do . . . . do

724	900	9	Native copper in veinstone containing epidote with veins of quartz and calc. spar mixed	do do
725	901	9	Do do do	do do
726	902	9	Native copper in epidote with veins of calc. spar	do do
727	903	9	Native copper in epidote containing quartz, calc. spar, and laumonite	do do
728	904	9	Native copper in epidote intersected by veins of chlorite rock showing slicken sides	do do
729	905	9	Native copper in a vein of quartz in chlorite rock	do do
730	906	9	Chlorite rock near the mine	do do
731	1001	10	Native copper in light-colored veinstone containing prehnite and calc. spar	do do
732	1002	10	Do do do	do do
733	1003	10	Do do do	do do
734	1004	10	Trap rock containing large quantity of chlorite	do do
735	829	8	Massive prehnite in calc. spar (veinstone)	Albion Company
736	830	8	Do do	do
737	831	8	Calc. spar with leonhardite (called veinstone)	do
738	832	8	Do do	do
739	833	8	Veinstone containing quartz, prehnite, and calc. spar, with chlorite rock	do
740	834	8	Calc. spar (veinstone)	do
741	835	8	Red slate (easily stains)	New York and Michigan Co. Agate harbor.
742	836	8	Veinstone with calc. spar (no copper apparent)	do do
743	1007	10	Native copper in veinstone with calc. spar	do do
744	1008	10	Do do	do do
745	1009	10	Native copper in veinstone containing epidote	do do
746	946	9	Red porphyry	Massachusetts Company
747	947	9	Porphyritic trap containing large crystals of feldspar and Babingtonite (?)	do do
748	948	9	Do do do	do do
749	949	9	Porphyritic trap containing large crystals of feldspar and Babingtonite (?) (more compact than the preceding)	do do
750	996	10	Native copper in porphyritic trap containing specular iron	Copper Rock Company
751	997	10	Porphyritic trap—fine crystals of red felspar	do do
752	998	10	Do do	do do
753	999	10	Native copper in porphyritic trap, containing specular iron quartz and calc. spar	do do
754	1000	10	Native copper in veinstone coated with chlorite	do do
755	1005	10	Veinstone showing slicken sides apparently talcose light green chlorite rock, alternated with quartz	Trap Rock Company
756	1006	10	Compact trap crystalline	do
757	363	3	Jasper probably formed by fusion of sandstone	Near Little Montreal river, lake shore
758	526	5	Boulder of porphyritic trap	Lake shore
759	527	5	Do	do
760	653	6	Black iron sand	Lake shore, Keweenaw Point
761	944	9	Breccia	Lake shore, ½ mile W. of Lake Superior Co.

Catalogue of rocks, minerals, and ores, collected during the years 1847 *and* 1848—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
762	945	9	Porphyritic trap	Lake shore, ½ mile E. of Montreal river
763	530	5	Green amygdaloid, colored by chlorite and epidote	Loose
764	576	5	Agate	Near end of Keweena Point
765	577	5	Do.	do.
766	584	6	Amygdaloid with amygdules of chlorite	Keweenaw Point
767	585	6	Scoria, from fusion of trap and sandstone	do.
768	588	6	Compact trap	do.
769	590	6	Ripple marks in sandstone	do.
770	592	6	Cornelian and calcedony or trap	do.
771	907	9	Porphyritic trap (feldspar stained green, resembling epidote)	do.
772	942	9	Agate	do.
773	629	6	Coarse red sandstone (feldspar and quartz)	4 miles E. of Portage
774	630	6	Do. do.	do.
775	631	6	Do. do.	do.
776	84	1	Native copper in epidote	Ohio and Isle Royal Co. Epidote L. R.
777	85	1	Do.	do. do.
778	86	1	Do.	do. do.
779	87	1	Do.	do. do.
780	88	1	Do.	do. do.
781	89	1	Do.	do. do.
782	90	1	Do.	do. do.
783	91	1	Do.	do. do.
784	92	1	Do.	do. do.
785	93	1	Do.	do. do.
786	94	1	Do.	do. do.
787	95	1	Native copper with datholite	do. do.
788	96	2	Do.	do. do.
789	162	2	Mass of native copper	do. do.
790	163	2	Do.	do. do.
791	164	2	Native copper in datholite	do. do.
792	165	2	Native copper in veinstone	do. do.
793	225	2	Native copper in epidote rock	do. do.
794	226	2	Do. do.	do. do.

795	227	2	Do.......do	do.......do
796	228	2	Do.......do	do.......do
797	229	2	Do.......do	do.......do
798	202	2	Red calc spar	do.......do
799	203	2	Do	do.......do
800	211	2	Jasper	Near lake shore. Epidote I. R.
801	240	2	Epidote rock, 6 feet thick, containing no copper directly beneath the copper-bearing epidote	Ohio and Isle Royal Co. Epidote I. R.
802	173	2	Native copper in datholite	Ohio and Isle Royal Co. Datholite I. R.
803	174	2	Native copper in datholite. Direction of vein N. 55 E., dip 51 W	do.......do
804	175	2	Native copper in datholite. Direction of vein N. 25 E., dip 55 W	do.......do
805	262	2	Native copper in veinstone with datholite. Direction of vein N. 25 E	do.......do
806	272	2	Datholite	do.......do
807	273	2	Native copper in datholite	do.......do
808	97	1	Native copper in veinstone	Ohio and Isle Royal Co. Rock Harbor. I. R.
809	98	1	Do.......do	do.......do
810	99	1	Do.......do	do.......do
811	100	1	Do.......do	do.......do
812	101	1	Do.......do	do.......do
813	102	1	Do.......do	do.......do
814	103	1	Do.......do	do.......do
815	104	1	Do.......do	do.......do
816	105	1	Do.......do	do.......do
817	106	1	Do.......do	do.......do
818	107	1	Do.......do	do.......do
819	108	1	Do.......do	do.......do
820	109	1	Native copper in epidote	do.......do
821	116	1	Quartz containing native copper	do.......do
822	110	1	Quartz and prehnite	do.......do
823	111	1	Do.......do	do.......do
824	112	1	Do.......do	do.......do
825	113	1	Quartz, prehnite and green carb. copper	do.......do
826	114	1	Quartz and prehnite with native copper	do.......do
827	115	1	Quartz containing native copper	do.......do
828	117	2	Quartz, prehnite and green carb. copper	do.......do
829	187	2	Trap	do.......do
830	189	2	Prehnite	do.......do
831	319	3	Crystals of quartz colored by red oxide of copper	do.......do
832	221	2	Native copper in indurated slate	Head of Rock Harbor. I. R.
833	222	2	Do.......do	do
834	223	2	Do.......do	do

Catalogue of rocks, minerals, and ores, collected during the years 1847 *and* 1848—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
835	224	2	Native copper in indurated slate	Head of Rock Harbor. I. R
836	235	2	Native copper in epidote rock containing carb. lime	do
837	236	2	Native copper in epidote rock	do
838	237	2	Do do	Near Rock Harbor
839	238	2	Do do	do
840	239	2	Do do	do
841	263	2	Silicate of iron	do
842	120	2	Native copper in trap	Scovill's point, I. R
843	121	2	Do do	do
844	122	2	Do do	do
845	123	2	Do do	do
846	124	2	Do do	do
847	125	2	Do do	do
848	126	2	Do do	do
849	127	2	Do do	do
850	128	2	Native copper in veinstone	do
851	129	2	Do do	do
852	130	2	Do do	do
853	131	2	Native copper in veinstone, with specular iron	do
854	132	2	Porphyritic trap, containing prehnite	do
855	133	2	Do do	do
856	137	2	Native copper in datholite	do
857	138	2	Native copper in veinstone, with calc. spar	do
858	139	2	Chocolate-colored amygdaloid, with native copper in prehnite	do
859	140	2	Native copper in prehnite	do
860	141	2	Scoria formed by fusion of trap and sandstone	do
861	230	2	Jacksonite and compact table spar	Scovill's point, I. R., on the forefinger 10 rods from the end, just beyond the point.
862	231	2	Do do	
863	232	2	Do do	Scovill's point, I. R.
864	233	2	Do do	do
865	264	2	Do do	do
866	265	2	Do do	do

867	266	2	Do. . . . . .do	. . . . .do
868	267	2	Do. . . . . .do	. . . . .do
869	268	2	Do. . . . . .do	. . . . .do
870	134	2	Native copper in veinstone	Scovill's point, J. R., Shaw's location
871	135	2	Do. . . . . .do	. . . . .do
872	136	2	Do. . . . . .do	. . . . .do
873	142	2	Native copper in veinstone, containing datholite	65, 35, 27, 4 rods from W. edge
874	143	2	Do. . . . . . . .do. . . . . .do	. . . . .do
875	144	2	Do. . . . . . . .do. . . . . .do	. . . . .do
876	145	2	Do. . . . . . . .do. . . . . .do	. . . . .do
877	179	2	Trap from a vein	65, 35, 27, corner
878	180	2	Veinstone, containing native copper and datholite	65, 35, 27, 4 rods from W. edge
879	182	2	Trap rock	65, 35, 26, and 27
880	204	2	Native copper in datholite	65, 35, 27, 4 rods from W. edge
881	208	2	Trap rock	65, 35, 28, and 33, 10 chs. from sec. corners 28, 29, 32, and 33.
882	245	2	Shot trap from bluff 20 feet high	65, 35, 28, and 29 S. of quarter post
883	177	2	Amygdaloid trap from a bluff 400 feet high	65, 36, 8 chs. of sec. corners 20, 21, 28, & 29.
884	247	2	Do. . . . . .do. . . . . . .do	. . . . .do
885	194	2	Native copper in epidote	65, 35, 26, lake shore
886	195	2	Do. . . . . .do	. . . . .do
887	178	2	Trap rock from a bluff	65, 35, 24
888	181	2	Do. . . . . . .do	65, 35, 23, and 24
889	191	2	Sandstone	65, 35, 25 NW. end of lake
890	192	2	Do	. . . . .do
891	207	2	Trap from a small bluff south of northeast end of lake	65, 35, 22
892	219	2	Native copper in prehnite	65, 35, 22 W. side of lake
893	220	2	Do. . . . . .do	. . . . .do
894	244	2	Erratic boulder of granite	65, 35, 21, and 22 NE. end of lake
895	190	2	Trap rock	65, 35, corner sections 15, 16, 21, and 22
896	197	2	Boulder of granite	65, 35, 20 on a trail 1 mile from N. shore
897	198	2	Trap rock	65, 35, 3
898	200	2	Do	65, 35, 3, and 4
899	199	2	Do	65, 35, 9, and 10
900	201	2	Do	. . . . .do
901	205	2	Do	65, 35, 8, and 9, 10 chs. from sec. corners 4, 5, 8, and 9.
902	206	2	Do	65, 35, 12
903	217	2	Quartz	. . . . .do
904	218	2	Do	65, 35, 17 on lake shore, near NW. cor. sec.
905	316	2	Native copper	65, 35, 4 rods from W. edge

Catalogue of rocks, minerals, and ores, collected during the years 1847 and 1848—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
906	166	2	Native copper in prehnite	65, 36, 17, lake shore.
907	176	2	Native copper in trappose veinstone	65, 36, 18, 15 chs. from E. line.
908	213	2	Veinstone in trap	65, 36, 17, lake shore, near NE. line.
909	241	2	Native copper in prehnite	65, 36, 17, lake shore, near NW. corner.
910	242	2	Do. do.	do.
911	243	2	Do. do.	do.
912	246	2	Quartz crystals	65, 36, 17, lake shore.
913	261	2	Porphyritic trap	65, 36, 17, near E. line.
914	196	3	Trap containing epidote	64, 37, on a stream between sec's 33 & 34.
915	210	2	Junction of trap and sandstone	do.
916	211	2	Do. do.	do.
917	146	2	Native copper in veinstone	Whittlesey's Union Co., I. R.
918	148	2	Do. do.	do.
919	149	2	Native copper and calc. spar	do.
920	150	2	Native copper and datholite	do.
921	150	2	Native copper in veinstone	do.
922	151	2	Do do.	do.
923	152	2	Do. do.	do.
924	153	2	Mass of native copper	do.
925	154	2	Do.	do.
926	155	2	Native copper in datholite	do.
927	156	2	Native copper in calc. spar	do.
928	157	2	Native copper in datholite	do.
929	158	2	Native copper in pebble, Lake Shore, near Union county	do.
930	159	2	Do. do. do.	do.
931	160	2	Do. do. do.	do.
932	161	2	Do. do. do.	do.
933	167	2	Native copper in veinstone, with datholite	Conglomerate Bay, I. R.
934	168	2	Do. do. do.	do.
935	169	2	Do. do. do.	do.
936	170	2	Do. do. do.	do.
937	171	2	Do. do. do.	do.
938	172	2	Do. do. do.	do.

939	212	2	Veinstone trap	do.
940	248	2	Vesicular amygdaloid	do.
941	249	2	Do.	do.
942	250	2	Do.	do.
943	251	2	Trap rock with quartz and calc. spar, (no copper)	do.
944	252	2	Conglomerate containing agates	do.
945	253	2	Breccia	do.
946	254	2	Scoria	do.
947	255	2	Amygdaloidal trap containing epidote	do.
948	256	2	Amygdaloid with calcareous spar	do.
949	257	2	Trap breccia	do.
950	258	2	Jasper formed from sandstone	do.
951	259	2	Quartziferous porphyry boulder	do.
952	260	2	Sandstone showing leptaria resembling fucoids	do.
953	215	2	Red feldspar	Near Conglomerate Bay, I. R.
954	216	2	Do.	do.
955	274	3	Native copper in veinstone	Pittsburg and Isle Royal Company, Todd's Harbor, I. R.
956	275	3	Native copper in datholite	do.
957	276	3	Native copper in trap	do.
958	277	3	Native copper in veinstone	do.
959	278	3	Native copper in trap with datholite	do.
960	279	3	Native copper in veinstone	do.
961	280	3	Native copper in prehnite with calc. spar	do.
962	281	3	Native copper in prehnite with calc spar and chocolate colored trap	do.
963	284	3	Crystals of quartz and calc. spar	do.
964	285	3	Quartz and prehnite	do.
965	286	3	Native copper with quartz and hornblende	do.
966	287	3	Native copper in calc. spar vein	do.
967	288	3	Do. do.	do.
968	297	3	Native copper in prehnite with chlorite lining a cavity	do.
969	270	3	Do. do.	Washington Harbor, I. R.
970	289	3	Native copper in veinstone	Todd's Harbor' I. R.
971	290	3	Veinstone	do.
972	294	3	Native copper in prehnite and calc. spar	Amygdaloid and Isle Royal Company near Miller's Landing.
973	298	3	Do.	Small island near Miller's Landing
974	973	10	Amygdaloid, green base, containing amygdules of laumonite and calc. spar	McCuller's, Isle Royal
975	974	10	Do. do. do. do.	do.
976	975	10	Amygdaloid, dark red base, containing amygdules of laumonite and calc. spar	do.
977	976	10	Do. do. do. do.	do.

Catalogue of rocks, minerals, and ores, collected during the years 1847 *and* 1848——Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
978	183	2	Boulder and porphyry	Isle Royal
979	193	2	Indurated green slate, colored by chlorite	
980	209	2	Amygdaloidal trap containing prehnite	
981	234	2	Jacksonite and compact table spar boulder	Near Scovill's point, lake shore
982	269	3	Boulder containing native copper	Isle Royal
983	271	3	Boulder containing native copper in prehnite with datholite	do
984	282	3	Native copper in trap with calc. spar and druses of datholite	Isle Royal, north shore
985	283	3	Do do do	do
986	291	3	Native copper in veinstone, (resembles a nail piercing the rock)	do
987	292	3	Do do	do
988	293	3	Do do	do
989	295	3	Boulder containing native copper in prehnite	Lake shore
990	296	3	Boulder containing native copper in prehnite with datholite and calc. spar	do
991	318	3	Native copper in veinstone	North shore
992	302	3	Crystallized native copper and calc. spar	Isle Royal
993	308	3	Native copper in vein of prehnite	do
994	309	3	Do do	do
995	320	3	Trap rock with prehnite and quartz in fine crystals	do
996	314	3	Native copper	Small islands on north shore
997	315	3	Do	do
998	299	3	Native copper in prehnite with datholite	Lake shore
999	300	3	Do do	do
1000	301	3	Do do	do
1001	303	3	Native copper crystallized with datholite	do
1002	304	3	Pebble of agate	do
1003	305	3	Boulder containing agate and black quartz	do
1004	306	3	Druses of datholite, boulder	do
1005	307	3	Amygdaloidal trap, with native copper in prehnite	do
1006	310	3	Native copper in prehnite	Lake shore, loose
1007	311	3	Do do	do
1008	312	3	Do do	do
1009	313	3	Native copper in prehnite, with datholite	do
1010	317	3	Crystallized native copper in prehnite, with quartz	do

1011	118	2	Native silver and blende	British and N. American Co., Prince's Bay.
1012	119	2	Galena amethyst and calc. spar	Prince's vein, Spar island, Canada shore...
1013	184	2	Blende and calc. spar	do
1014	185	2	Copper pyrites	do
1015	186	2	Peacock ore	do
1016	188	2	Copper pyrites, blende, and native silver	Prince's vein, Spar island, Canada shore...

Catalogue of rocks, minerals, ores, and fossils, collected by Dr. John Locke.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
1	4	1	Iron pyrites, galena, and calc. spar	Presque Isle
2	5	1	Do. do	do
3	8	1	Do. do	do
4	9	1	Do. do	do
5	10	1	Do. do	do
6	12	1	Do. do	do
7	15	1	Do. do	do
8	32	1	Do. do	do
9	37	1	Do. do	do
10	42	1	Do. do	do
11	48	1	Do. do	do
12	60	1	Do. do	do
13	89	1	Do. do	do
14	250	1	Do. do	do
15	252	1	Iron pyrites, galena, and calc. spar, (iron pyrites encrusting calc. spar)	do
16	479	1	Iron pyrites, galena, and calc. spar	do
17	13	1	Iron pyrites and (octohedral) galena	do
18	31	1	Do. do	do
19	45	1	Iron pyrites and dodecahedral galena, covered with minute crystals of pyrites	do
20	47	1	Iron pyrites and octohedral galena	do
21	49	1	Iron pyrites, octohedral galena, and calc. spar	do
22	51	1	Iron pyrites and galena	do
23	54	1	Do. do	do

Catalogue of rocks, minerals, ores, and fossils, collected by Dr. John Locke.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
24	58	1	Iron pyrites and galena, dodecahedral	Presque Isle.
25	59	1	Iron pyrites and galena, crystallized	do.
26	61	1	Do. do.	do.
27	62	1	Iron pyrites and galena, octahedral	do.
28	63	1	Do. do.	do.
29	64	1	Do. do.	do.
30	65	1	Do. do.	do.
31	66	1	Do. do.	do.
32	67	1	Do. do.	do.
33	68	1	Iron pyrites and galena, impressed	do.
34	70	1	Iron pyrites and galena	do.
35	76	L 1	Fine iron pyrites and galena, crystallized	do.
36	77	" 1	Do. do.	do.
37	78	" 1	Fine particle of iron pyrites and galena, octahedral	do.
38	90	" 1	Fine particle of iron pyrites, a fragment	do.
39	106	" 1	Do. do.	do.
40	494	" 1	Do. do.	do.
41	499	" 1	Do. do.	do.
42	509	" 1	Do. do.	do.
43	614	" 1	Iron pyrites and galena	do.
44	615	" 1	Do.	do.
45	6	" 1	Crystals of iron pyrites and calc. spar, six sided prisms	do.
46	14	" 1	Do. do.	do.
47	16	" 1	Do. do.	do.
48	17	" 1	Iridescent iron pyrites and calc. spar	do.
49	18	" 1	Do.	do.
50	19	" 1	Crystals of iron pyrites and calc. spar, crystallized	do.
51	20	" 1	Crystals of iron pyrites and calc. spar, in a green rock apparently colored by epidote	do. do.
52	21	" 1	Do. do.	do.
53	22	" 1	Do. do.	do.
54	28	" 1	Do. do.	do.
55	29	" 1	Botryoidal iron pyrites and calc. spar	do.

56	35	" 1	Do	do
57	46	" 1	Do	do
58	47	" 1	Do	do
59	55	" 1	Do	do
60	87	" 1	Do	do
61	91	" 1	Do	do
62	101	" 1	Do	do
63	478½	" 1	Do	do
64	480	" 1	Cubic iron pyrites and calc. spar, in short prisms	do
65	502	" 1	Cubic iron pyrites and calc. spar, in yellow silicious rock	do
66	25	" 1	Cubic galena and calc. spar	do
67	57	" 1	Impressed galena and calc. spar	do
68	92	" 1	Impressed galena and calc. spar (form of galena octahedral)	do
69	96	" 1	Octahedral galena and calc. spar (surface of galena decrystallized)	do
70	477	" 1	Octahedral galena and calc. spar hexahedral	do
71	647	" 1	Octahedral galena and iron pyrites, in decomposed rock	do
72	648	" 1	Crystallized galena and iron pyrites, in decomposed rock	do
73	23	" 1	Iron pyrites, in green rock	do
74	24	" 1	Galena and pseudomorphous pyrites taking the form of the pentagonal termination of calc. spar	do
75	26	" 1	Iron pyrites	do
76	33	" 1	Galena and calc. spar	do
77	38	" 1	Iron pyrites, in the rock	do
78	39	" 1	Do	do
79	56	" 1	Do	do
80	74	" 1	Do	do
81	83	" 1	Iron pyrites, iridescent	do
82	86	" 1	Do	do
83	93	" 1	Do	do
84	251	" 1	Do	do
85	506	" 1	Iron pyrites and peroxide of iron	do
86	507	" 1	Do	do
87	534	" 1	Do	do
88	617	" 1	Do	do
89	631	" 1	Do	do
90	632	" 1	Do	do
91	633	" 1	Do	do
92	647	" 1	Do	do
93	648	" 1	Do	do
94	27	" 1	Calc. spar, crystallized	do
95	50	" 1	Calc. spar, six sided prisms	do

Catalogue of rocks, minerals, ores, and fossils, collected by Dr. John Locke—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
96	105	L 1	Calc. spar, six sided prisms terminated by three pentagonal faces, external layer opaque, interior transparent	Presque Isle
97	492	" 1	Dog tooth spar	do.
98	497	" 1	Calc. spar, hexahedral, retained by Dr. J.	do.
99	30	" 1	Galena, dodecahedral	do.
100	36	" 1	Do.	do.
101	41	" 1	Do.	do.
102	43	" 1	Do.	do.
103	44	" 1	Do.	do.
104	69	" 1	Galena, octahedral	do.
105	72	" 1	Do.	do.
106	73	" 1	Do.	do.
107	75	" 1	Galena, dodecahedral	do.
108	80	" 1	Do.	do.
109	81	" 1	Galena and calc. spar	do.
110	82	" 1	Do.	do.
111	84	" 1	Do.	do.
112	85	" 1	Galena, three separate dodecahedral crystals	do.
113	94	" 1	Galena, octahedral	do.
114	95	" 1	Do.	do.
115	97	" 1	Do.	do.
116	98	" 1	Do.	do.
117	103	" 1	Do.	do.
118	115	" 1	Do.	do.
119	116	" 1	Galena, octahedral, passing into dodecahedral	do.
120	117	" 1	Galena, dodecahedral	do.
121	505	" 1	Galena	do.
122	508	" 1	Do.	do.
123	616	" 1	Do.	do.
124	114	" 1	Iron pyrites and asbestos	do.
125	478	" 1	Blende in a vein of quartz, with galena	do.
126	493	" 1	Galena and asbestos	do.
127	495	" 1	Black calc. spar, sulphuret of copper and carb. lime	do.

128	496	" 1	Quartz, dog-tooth spar, iron pyrites and galena	do.
129	498	" 1	Calc. spar, containing pyrites surrounded by globules of gypsum, derived from decomposition of pyrites	do.
130	99	" 1	Decomposed jaspery agate vein	do.
131	102	" 1	Vein of jasper in indurated micaceous sandstone	do.
132	119	" 1	Vein of resinous-looking red jasper in chlorite rock	do.
133	122	" 1	Jasper with a resinous lustre	do.
134	124	" 1	Small vein of jasper in trap	do.
135	163	" 1	Jasper breccia	do.
136	164	" 1	Veins of jasper in trap	do.
137	104	" 1	Drusy quartz	do.
138	110	" 1	Silicious rock	do.
139	113	" 1	Small quartz vein in a ferruginous rock	do.
140	118	" 1	Silicious rock	do.
141	123	" 1	Cacholony in trap	do.
142	126	" 1	Quartz in brown silicious rock	do.
143	167	" 1	Drusy quartz	do.
144	253	" 1	Ferruginous quartz from indurated sandstone	do.
145	1	" 1	Coarse gray sandstone, containing pebbles of quartz and crystals of feldspar cemented by a greenish paste	do.
146	2	" 1	Do ......do......do......do	do.
147	3	" 1	Do ......do......do......do	do.
148	7	" 1	Veinstone, containing carbonate of lime and a little chlorite	do.
149	34	" 1	Pebble of chlorite rock intersected by white veins	do.
150	79	" 1	Veins of compact table spar in trap	do.
151	99	" 1	Nodule of altered sandstone, greenish from epidote	do.
152	161	" 1	Red and gray sandstone with red chalk	do.
153	162	" 1	Altered sandstone, containing carb. of lime	do.
154	165	" 1	Gray sandstone, encrusted with carb. of copper	do.
155	169	" 1	Trap rock, very ferruginous	do.
156	222	" 1	Serpentine	do.
157	501	" 1	Do	do.
158	503	" 1	Do	do.
159	504	" 1	Asbestos	do.
160	500	" 1	Carbonate of lime and iron	do.
161	107	" 1	Slaty red hematite	do.
162	108	" 1	Do	do.
163	109	" 1	Do	do.
164	111	" 1	Do	do.
165	112	" 1	Fragment of a vein of red silicious matter in green altered sandstone	do.
166	121	" 1	Red hematite in a silicious breccia	do.

Catalogue of rocks, minerals, ores, and fossils, collected by Dr. John Locke—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
167	120	L 1	Compact red hematite	Presque Isle
168	163	" 1	Earthy silicious red hematite	do.
169	166	" 1	Pebble of rich red hematite	do.
170	177	" 1	Red hematite	do.
171	125	" 1	Yellow epidote rock with coarse veins	do.
172	127	" 1	Black trap	do.
173	128	" 1	Do	do.
174	129	" 1	Red slate, reticulated with veins of carb. lime	do.
175	130	" 1	Do. do	do.
176	131	" 1	Altered sandstone, containing pebbles of quartz	do.
177	132	" 1	Do. do	do.
178	133	" 1	Dark brown sandstone, containing pebbles of quartz	do.
179	134	" 1	Do. do. do	do.
180	135	" 1	Jaspery altered rock, veins of quartz	do.
181	136	" 1	Do. do	do.
182	137	" 1	Portion of conglomerate indurated, containing porphyry and micaceous sandstone	do.
183	138	" 1	Do. do. do. do	do.
184	139	" 1	Red sandstone, composed of grains of quartz, peroxide of iron and decomposed feldspar	do.
185	140	" 1	Do. do. do. do	do.
186	170	" 1	Red slate coated with peroxide of iron and glazed	L' Anse
187	174	" 1	Red slate	do.
188	554	" 1	Do	do.
189	555	" 1	Red slate coated with peroxide of iron and glazed	do.
190	173	" 1	Gray slate	do.
191	175	" 1	Do	do.
192	207	" 1	Novaculite, drab colored	do.
193	208	" 1	Do. do	do.
194	209	" 1	Do. do	do.
195	210	" 1	Do. do	do.
196	482	" 1	Novaculite	do.
197	483	" 1	Novaculite slate	do.

198	486	" 1	Novaculite		do
199	556	" 1	Red chalk, rather hard		do
200	171	" 1	Gray sandstone		do
201	484	" 1	Compact quartzy sandstone overlying trap		do
202	488	" 1	Indurated sandstone, quartz and decomposed feldspar		do
203	172	" 1	Ferruginous quartz		do
204	481	" 1	Ferruginous quartz		L'Anse
205	487	" 1	Quartz		do
206	489	" 1	Do		do
207	490	" 1	Do		do
208	491	" 1	Quartz and kaolin		do
209	176	" 1	Iron ore—peroxide—stratified		Jackson mine
210	178	" 1	Do.....do		do
211	179	" 1	Do.....do.............(Retained by Dr. J.)		do
212	266	" 1	Do.....do		do
213	267	" 1	Compact red iron ore		Cleveland Loc.
214	268	" 1	Do.............(Retained by Dr. J.)		do
215	510	" 1	Do		do
216	182	" 1	Slaty iron ore		Jackson mine
217	529	" 1	Slaty iron ore compact		do
218	512	" 1	Granular iron ore		do
219	514	" 1	Do..........(Retained by Dr. J.)		do
220	533	" 1	Do		do
221	184	" 1	Red iron ore with jaspery bands—curved strata		do
222	187	" 1	Do...........do...............do		do
223	183	" 1	Red iron ore with jaspery bands		do
224	511	" 1	Do...........do		do
225	513	" 1	Do...........do		do
226	188	" 1	Jaspery iron ore		do
227	595	" 1	Poor silicious iron ore		do
228	180	" 1	Red hematite		do
229	181	" 1	Chlorite slate		do
230	339	" 3	Purple copper ore	B	Bruce mine
231	346	" 3	Do	A	do
232	349	" 3	Do	A	do
233	351	" 3	Purple copper ore in quartz	C	do
234	352	" 3	Do...............do	C	do
235	354	" 3	Do...............do	A	do
236	360	" 3	Purple copper ore	B	do
237	364	" 3	Do	A	do
238	365	" 3	Do.................(Retained by Dr. J.)	A	do

Catalogue of rocks, minerals, ores, and fossils, collected by Dr. John Locke—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.		Locality.
239	374	L 3	Purple copper ore	A	Bruce mine
240	376	" 3	Do	A	do
241	387	" 3	Do	A	do
242	388	" 3	Do	A	do
243	394	" 3	Do	A	do
244	397	" 3	Do	A	do
245	403	" 3	Do	B	do
246	407	" 3	Do	B	do
247	408	" 3	Do	A	do
248	410	" 3	Do	A	do
249	411	" 3	Do		do
250	335	" 3	Purple copper pyrites and quartz	B	do
251	336	" 3	Do ... do ... do	B	do
252	341	" 3	Do ... do ... do	B	do
253	340	" 3	Copper pyrites, yellow	C	do
254	342	" 3	Copper pyrites in quartz	C	do
255	343	" 3	Copper pyrites in quartz, with iridescent copper	C	do
256	345	" 3	Copper pyrites in quartz	C	do
257	353	" 3	Do ... do	C	do
258	355	" 3	Copper pyrites		do
259	356	" 3	Do	B	do
260	363	" 3	Do	B	do
261	366	" 3	Do	B	do
262	367	" 3	Do	C	do
263	368	" 3	Do ... (Retained by Dr J.)	B	do
264	370	" 3	Do		do
265	373	" 3	Do	C	do
266	375	" 3	Do	C	do
267	377	" 3	Do	C	do
268	378	" 3	Do	B	do
269	379	" 3	Do	C	do
270	380	" 3	Do		do
271	381	" 3	Do	C	do

272	382	" 3	Do	B	do.
273	383	" 3	Do.		do.
274	384	" 3	Do	C	do.
275	385	" 3	Do	C	do.
276	386	" 3	Do	B	do.
277	389	" 3	Do	B	do.
278	390	" 3	Do	C	do.
279	391	" 3	Do	B	do.
280	392	" 3	Do	B	do.
281	393	" 3	Do	C	do.
282	401	" 3	Do	B	do.
283	405	" 3	Do	A	do.
284	409	" 3	Do	C	do.
285	414	" 3	Do.		do.
286	427	" 3	Do	C	do.
287	426	" 3	Copper pyrites in sienite, wall vein	C	do.
288	358	" 3	Gray copper ore	A	do.
289	359	" 3	Gray copper ore—quartz and green carb., (first discovery of the mine,)		do.
290	362	" 3	Gray copper ore	A	do.
291	369	" 3	Do	A	do.
292	371	" 3	Gray copper ore, coated with green carb	A	do.
293	396	" 3	Do..........do.		do.
294	404	" 3	Gray copper ore	C	do.
295	413	" 3	Do	C	do.
296	594	" 3	Do		do.
297	398	" 3	Carbonate of copper	C	do.
298	348	" 3	Quartz, with a little carb. of copper		do.
299	361	" 3	Do..........do.		do.
300	337	" 3	Quartziferous trap rock gangue		do.
301	337½	" 3	Fragment of trap dyke in decomposed feldspathic rock		do.
302	338	" 3	Trap rock		do.
303	344	" 3	Trap rock, consisting of hornblende and feldspar	B	do.
304	347	" 3	Trap rock porphyritic	A	do.
305	350	" 3	Do.......do.	B	do.
306	372	" 3	Trap rock	C	do.
307	406	" 3	Do	B	do.
308	415	" 3	Trap rock, resembling sienite	C	do.
309	416	" 3	Trap rock		do.
310	418	" 3	Do	C	do.
311	412	" 3	Sienite, decomposed	C	do.
312	417	" 3	Sienite, hornblende and feldspar		do.

Catalogue of rocks, minerals, ores, and fossils, collected by Dr. John Locke—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
313	420	L 3	Sienite	Bruce mine
314	424	" 3	Do	do
315	421	" 3	Hornblende rock, consisting of hornblende and feldspar	do
316	422	" 3	Do do do	do
317	423	" 3	Do do do	do
318	435	" 3	Hornblende rock	do
319	425	" 3	Chlorite slate, next to vein, the wall	do
320	428	" 3	Breccia, jasper and quartz	2 miles west of Bruce mine
321	429	" 3	Do do	do
322	430	" 3	Do do	do
323	431	" 3	Do do	do
324	434	" 3	Jasper breccia	do
325	433	" 3	Bluff and red jasper in place	do
326	436	" 3	Trap rock	do
327	439	" 3	Limestone	do
328	441	" 3	Do	do
329	442	" 3	Do	do
330	440	" 3	Indurated chlorite slate	do
331	443	" 3	Coarse gray sandstone	Grand Island
332	444	" 3	Do do	do
333	448	" 3	Do do	do
334	445	" 3	Red sandstone	do
335	453	" 3	Do	do
336	446	" 3	Red and gray sandstone	do
337	447	" 3	Do do	do
338	449	" 3	Fine white sandstone	Grand Portal
339	451	" 3	Do do	do
340	452	" 3	Do do	do
341	450	" 3	Coarse sandstone	do
342	557	" 4	Nodules stained with oxide of iron in white sandstone and nodules of oxide of iron	do
543	558	" 4	Do do do do	do
344	559	" 4	Do do do do	do
345	560	" 4	Do do do do	do

346	561	" 4	Do.....do.....do.....do	do
347	562	" 4	Do.....do.....do.....do	do
348	563	" 4	Do.....do.....do.....do	do
349	564	" 4	Do.....do.....do.....do	do
350	565	" 4	Do.....do.....do.....do	do
351	566	" 4	Do.....do.....do.....do	do
352	567	" 4	Do.....do.....do.....do	do
353	568	" 4	Do.....do.....do.....do	do
354	569	" 4	Do.....do.....do.....do	do
355	570	" 4	Do.....do.....do.....do	do
356	571	" 4	Do.....do.....do.....do	do
357	572	" 4	Do.....do.....do.....do	do
358	573	" 4	Do.....do.....do.....do	do
359	574	" 4	Do.....do.....do.....do	do
360	575	" 4	Do.....do.....do.....do	do
361	576	" 4	Do.....do.....do.....do	do
362	577	" 4	Do.....do.....do.....do	do
363	578	" 4	Do.....do.....do.....do	do
364	579	" 4	Do.....do.....do.....do	do
365	580	" 4	Do.....do.....do.....do	do
366	581	" 4	Do.....do.....do.....do	do
367	582	" 4	Do.....do.....do.....do	do
368	584	" 4	Nodules of peroxide of iron in white sandstone	do
369	585	" 4	Do.....do.....do	do
370	586	" 4	Do.....do.....do	do
371	587	" 4	Do.....do.....do	do
372	588	" 4	Nodules of peroxide of iron in white sandstone	do
373	589	" 4	Do.....do	
374	590	" 4	Do.....do	
375	591	" 4	Do.....do	
376	592	" 4	Do.....do	
377	583	" 4	Pseudomorphous carbonate of lime in peroxide of iron	
378	627	" 4	Vein of sulphate of baryta in coarse gray sandstone	
379	628	" 4	Do.....do	
380	629	" 4	Do.....do	
381	454	" 3	White sandstone	Portal rock
382	620	" 4	Fine gray sandstone	do
383	455	" 3	Nodule of calcareous rock	Portal cave
384	456	" 3	Fucoides duplexus in white sandstone, (retained by Dr. Jackson,)	Grand Portal cave
385	457	" 3	Do.....do.....do	do
386	458	" 3	Fucoides duplexus in white sandstone	do

Catalogue of rocks, minerals, ores, and fossils, collected by Dr. John Locke—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
387	459	L 3	Fucoides duplexus in white sandstone	Grand Portal cave
388	460	" 3	Do.................do	
389	461	" 3	Do.................do	
390	462	" 3	Fucoides duplexus in white sandstone, (retained by Dr. Jackson,)	
391	463	" 3	Fucoides duplexus in white sandstone	
392	464	" 3	Fucoides duplexus in white sandstone, (retained by Dr. Jackson,)	
393	465	" 3	Fucoides duplexus in white sandstone	
394	466	" 3	Do.................do	
395	467	" 3	Fucoides duplexus in white sandstone, (retained by Dr. Jackson,)	
396	468	" 3	Fucoides duplexus in white sandstone	
397	469	" 3	Fucoides duplexus in white sandstone, (retained by Dr. Jackson,)	
398	470	" 3	Fucoides duplexus in white sandstone	
399	471	" 3	Fucoides duplexus in white sandstone, (retained by Dr. Jackson,)	do
400	335	" 3	Sandstone and conglomerate of quartz pebbles	Pictured rocks (probably)
401	646	" 4	Gray sandstone stained with carbonate of copper	do
402	287	" 3	Buff sandstone	Near head of the rapids of Sault St. Marie.
403	288	" 3	Do	do
404	292	" 3	Do	do
405	294	" 3	Do	do
406	297½	" 3	Do	do
407	299	" 3	Gray sandstone	do
408	289	" 3	Red sandstone, mottled	do
409	290	" 3	Red sandstone	do
410	291	" 3	Do	do
411	295	" 3	Do	do
412	296	" 3	Red sandstone, mottled	do
413	297	" 3	Do.......... do	do
414	293	" 3	Red sandstone	do
415	298	" 3	Red and gray sandstone, mottled	do
416	300	" 3	Copper pyrites, in quartz	Echo lake
417	301	" 3	Do.........do	do
418	302	" 3	Do.........do	do
419	303	" 3	Do.........do	do

420	304	" 3	Do........do	..........do
421	305	" 3	Do........do	..........do
422	306	" 3	Do........do	..........do
423	307	" 3	Do........do	..........do
424	308	" 3	Do........do	..........do
425	309	" 3	Do........do	..........do
426	310	" 3	Do........do	..........do
427	395	" 3	Do........do	..........do
428	399	" 3	Do........do	..........do
429	402	" 3	Do........do	..........do
430	311	" 3	Bluish gray compact limestone	..........do
431	312	" 3	Do...........do	..........do
432	317	" 3	Limestone eroded by water, showing strata	..........do
433	318	" 3	Limestone eroded by water, less acted upon	..........do
434	319	" 3	Limestone eroded by water	..........do
435	320	" 3	Do..........do	..........do
436	325	" 3	Limestone compact, retained for analysis	..........do
437	326	" 3	Limestone eroded by water, showing strata	..........do
438	327	" 3	Limestone eroded by water	..........do
439	330	" 3	Do..........do	..........do
440	632	" 3	Do..........do	..........do
441	329	" 3	Limestone shewing drift scratches	..........do
442	313	" 3	Chlorite slate containing pebbles of quartz and feldspar	..........do
443	314	" 3	Do...............do.............. do	..........do
444	324	" 3	Chlorite slate containing scattered nodules of feldspar rock	..........do
445	328	" 3	Chlorite slate	..........do
446	331	" 3	Silicious indurated slate	..........do
447	321	" 3	Trap rock	..........do
448	322	" 3	Do	..........do
449	323	" 3	Do	..........do
450	333	" 3	White sandstone from a boulder	W. camp, August 10
451	334	" 3	White sandstone from a boulder	Near camp; August 10
				T. R. S
452	186	" 4	Indurated slate, containing pyrites	48, 25, 2.—Cross island
453	255	" 4	Indurated slate	..........do
454	216	" 4	Rock composed of feldspar and quartz	..........do
455	226	" 4	Rock composed of green feldspar and quartz	..........do
456	230	" 4	Quartz	48, 25, 2
457	189	" 4	Green slate, with vein of carb. lime	48, 25, 11, Dead River Falls
458	193	" 4	Do.....................do	48, 25, 11
459	194	" 4	Green slate, with vein of magnesian limestone	....do

Catalogue of rocks, minerals, ores, and fossils, collected by Dr. John Locke—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
				T. R. S.
460	243	L 4	Green slate, with vein of carb. lime	48, 25, 11, Dead River Falls
461	244	" 4	Do ..do	48, 25, 11
462	190	" 4	Magnesian limestone, pink colored	do
463	191	" 4	Magnesian limestone, pink colored, in slate	do
464	192	" 4	Magnesian limestone, pink colored	do
465	262	" 4	Magnesian limestone, vein, (retained by Dr. J.)	do
466	265	" 4	Magnesian limestone, vein	do
467	195	" 4	Flesh colored feldspar and quartz rock, porphyry (?)	do
468	283	" 4	Pebble of breccia, decomposed feldspar and iron ore	Mouth of Dead river
469	197	" 4	Flesh colored feldspar and quartz, fine grained porphyry?	Middle island
470	200	" 4	Rock composed of feldspar and quartz	do
471	612	" 4	Do ..do	Middle island, S. end of island
472	198	" 4	Argillaceous slate	Middle island
473	199	" 4	Compact slate, containing pyrites	do
474	204	" 4	Brown slate	do
475	205	" 4	Altered slate	do
476	206	" 4	Chlorite slate	do
477	261	" 4	Green slate	do
478	201	" 4	Hornblende slate	do
479	203	" 4	Hornblende rock passing into sienite, red feldspar	do
480	202	" 4	Sienite, composed principally of hornblende and a little red feldspar	do
481	203	" 4	Compact black trap	do
		" 4	Hornblende rock, vein of sienite	do
482	254			
483	211	" 4	Calc. spar in indurated sandstone	49, 25, 34, Granite Point
484	263	" 4	Calc. spar in red sandstone	49, 25, 34
485	212	" 4	Light green hornblende rock, a boulder	do
486	214	" 4	Lamellar hornblende rock, a boulder	do
487	215	" 4	Do ..do	do
488	259	" 4	Do ..do	do
489	260	" 4	Do ..do	do
490	219	" 4	Slate rock	do

491	220	" 4	Greenish and red nodule, from sandstone near the trap	do
492	242	" 4	Brownish red sandstone	do
493	249	" 4	Red feldspar and vein of calc spar	do
494	257	" 4	Red feldspar crystallized	do
495	217	" 4	Hornblende rock	48, 25, 2, Savine island
496	221	" 4	Red feldspar, porphyry	do. do
497	225	" 4	Porphyry	48, 25, 2
498	283	" 4	Rock composed of feldspar and quartz	48, 25, 11, Dead river
499	223	" 4	Chlorite suitable for making pipes, spec. grav. 2.90	Carp River post office
500	269	" 4	Do do	do
501	516	" 4	Do do	do
502	224	" 4	Quartz rock	do
503	609	" 4	Granular quartz rock, mottled with red	do
504	610	" 4	Granular quartz rock, mottled with red, (see No. 560)	do
505	553	" 4	Chlorite in rock, composed of chlorite and felspar	Carp river
506	608	" 4	Compact calciferous slate, containing iron pyrites	do
507	618	" 4	Compact blue limestone, containing iron pyrites	do
508	541	" 4	Trap rock, green feldspar, near slate	1 mile N. of Carp river, Lake shore
509	227	" 4	Granular white quartz, (probably altered sandstone)	Head of Upper Nubish Rapids
510	228	" 4	Granular pink quartz, (probably altered sandstone)	do
511	229	" 4	Do do	do
512	284	" 4	Granular white quartz, (probably altered sandstone)	Nubish Rapids
513	286	" 4	Do do	do
514	274	" 4	Granular quartz, altered sandstone	do
515	275	" 4	Do do	do
516	276	" 4	Altered sandstone, fine grained, compact, large grooves	do
517	277	" 4	Altered sandstone, compact	do
518	278	" 4	Altered sandstone, compact, grooved	do
519	279	" 4	Altered sandstone, compact	do
520	218	" 4	Sienite, coated with epidote	49, 25, 29, near Mount Burt
521	238	" 4	Do do	do
522	245	" 4	Do do	do
523	234	" 4	Sienite, in place	do
524	246	" 4	Sienite, coarse grained	do
525	247	" 4	Sienite, fine grained	do
526	248	" 4	Do	do
527	280	" 4	Sienite, coarse, composed of large crystals of hornblende and feldspar	do
528	281	" 4	Trap rock, 20 feet dyke, sides No. 1	Mount Burt
529	282	" 4	Trap rock, 20 feet dyke, middle No. 2	do
530	232	" 4	Red porphyry, large crystals, red feldspar, and large grains quartz, with carb. lime boulder	49, 25, 29, near Mount Burt

Catalogue of rocks, minerals, ores, and fossils, collected by Dr. John Locke—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
				T. R. S.
531	236	L 4	Rock composed of feldspar and quartz	49, 25, 29, near Mount Burt
532	264	" 4	Epidote	Near Mount Burt, on shore
533	270	" 4	Drab colored novaculite, hard and compact, superior quality, (retained by Dr. J.)	48, 26, 30, Teal lake
534	272	" 4	Dark colored novaculite, hard and compact, superior quality, (see 561)	do.
535	530	" 4	White sandstone, containing a little carb. lime	Near Tobacco river
536	531	" 4	Do do	do.
537	622	" 4	Coarse gray sandstone	Near Miners' river
538	626	" 4	Do	do.
539	543	" 4	Quartz and red feldspar. Standard No. 2	46, 26, 6
540	542	" 4	Quartz and flesh-colored feldspar	46, 27, 25, Eskanawby rapids
541	544	" 4	Rock composed of blue quartz and white feldspar	46, 26, 30, Eskanawby rapids
542	545	" 4	Rock composed of large crystals of blue quartz and red feldspar	46, 26, 31, Great Falls of Eskanawby
543	546	" 4	Light-red sandstone	From a point west of Train point
544	547	" 4	Do do	do.
545	548	" 4	Red and white sandstone	do.
546	552	" 4	White sandstone	do.
547	549	" 4	Vein of sulphate of baryta in sandstone	do.
548	550	" 4	Do do	do.
549	551	" 4	Do do	do.
550	611	" 4	Green trap rock versicular covered with fine crystals of epidote	Gros Cap
551	635	" 4	Trap rock containing nodules of chlorite and epidote	do
552	640	" 4	Amygdaloidal trap	do
553	641	" 4	Trap rock containing leonhardite	do
554	642	" 4	Amygdaloidal trap amygdules of a bright red mineral (retained for analysis)	do
555	644	" 4	Rock composed of feldspar, chlorite, and quartz	do
556	634	" 4	Vein of quartz	do.
557	638	" 4	Carb. lime with a slight coating of carb. of copper	do
558	639	" 4	Epidote	do.
559	645	" 4	Epidote nodule	do
560	606	" 4	Pink-colored talcose slate (should follow 504)	Carp river post office
561	527	" 4	Novaculite, drab-colored, yields to knife, good quality (should follow 534)	48, 26, 30, Teal lake
562	520	" 4	Quartz containing specks of copper pyrites	48, 26, 26

563	521	" 4	Quartz containing specks of copper pyrites with chlorite	48, 26, 28 S. E. $\frac{1}{4}$ sec
564	522	" 4	Quartz containing copper pyrites	do
565	526	" 4	Chlorite slate	do
566	593	" 4	Iron pyrites in slate	do
567	523	" 4	Slate with quartz	48, 26
568	524	" 4	Slate with carb. of lime	48, 26
569	535	" 4	Compact, fine-grained, slaty, magnetic iron with polarity	48, 26 $\frac{1}{8}$ mile N. of sec 18
570	536	" 4	Do. do. do	do
571	537	" 4	Do. do. do	do
572	539	" 4	Compact, fine-grained, slaty, magnetic iron with polarity (retained for analysis)	do
573	540	" 4	Green hornblende rock, standard specimen No. 1	47, 26, 18
574	518	" 4	Chlorite rock containing carb. lime and pyrites	
575	525	" 4	Compact pyritiferous slate containing carb. lime	
576	605	" 4	Pyritiferous slate	
577	623	" 4	Acicular crystals of sulphate of lime	
578	624	" 4	Do. do	
579	842	" 4	Orthocera (fragment) (retained by Dr. J.)	St. Joseph's
580	650	" 4	A, part belonging to the great Orthocera, at the point A to be glued on	do
581	651	" 2	B, part belonging to the great Orthocera, at the point B to be glued on	
582	649	Long box.	Great orthocera, 5 feet long, 8 inches in diameter, joints about three to the inch, making in all about 180 chambers. Siphuncle large, well marked, and filled with crystals, (see drawing.) Posterior end contracts abruptly within 2 or 3 inches of the termination	
	652 to 841	L 2	All the same fossil, Pentamerus oblongus	T. RE. G. 42, 4, 17
			Nos. 750, 780, 781, 782, 783, 784, 785, 787, 788, and 789 are missing	
			Nos. 660, 680, 710, 711, 734, 738, 768, 798, 815, and 826 retained for examination and analysis of limestone	

Catalogue of rocks, minerals, &c., collected by J. W. Foster.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
1	1	F 1	Ferruginous sandstone, base of silurian	Below Chippewa island, Menomoneek
2	2	" 1	Do. ... do	do
3	3	" 1	Do. ... do	do
4	29	W 1	Red quartziferous porphyry, large crystals of red feldspar, (probably erratic)	do
5	30	F 1	Do. ... do ... do	do
6	31	" 1	Do. ... do ... do	do
7	27	" 1	Compact trap (marked "Basalt" F.)	¼ mile below Chippewa isl'd, Menomoneek.
8	28	" 1	Do. ... do	do
9	34	" 1	Sienite	1 mile below Chippewa isl'd, Menomoneek.
10	32	" 1	Indurated slate with jaspery pebbles	¼ mile below Chippewa isl'd, Menomoneek.
11	33	" 1	Indurated slate, with narrow band of jasper	do
12	21	" 1	Talcose slate, silver gray color	Chippewa island, Menomoneek
13	22	" 1	Do. ... do	do
14	23	" 1	Do. ... do	do
15	24	" 1	Talcose slate, reddish color	do
16	25	" 1	Altered slate, contact with trap, contains pyrites	do
17	26	" 1	Do. ... do ... do	do
18	4	" 1	Calciferous sandstone, lower silurian	33, 28, Caulkin's saw mill, Menomoneek
19	5	" 1	Limestone, lower silurian	do
20	6	" 1	Sandstone, base of silurian	White rapids, Menomoneek
21	7	" 1	White sandstone, silurian	do
22	8	" 1	Red sandstone, fine grained and compact, lower silurian	Grand rapids, Menomoneek
23	9	" 1	Do. ... do ... do	do
24	10	" 1	Drab colored magnesian limestone, lower silurian	do
25	11	" 1	Do. ... do	do
26	12	" 1	Granular brown magnesian sandstone, lower silurian	do
27	13	" 1	Do. ... do	do
28	35	" 1	Granular quartz, supposed to be indurated white sandstone with ripple marks, loose	Twin falls, Menomoneek
29	36	" 1	Granular limestone	Upper Twin falls, Menomoneek
30	37	" 1	Granular limestone, containing zoisite (?)	do
31	40	" 1	Do. ... do	do
32	42	" 1	Do. ... do	do

33	41	" 1	Granular limestone and quartz, containing zoisite (?)	do.
34	38	" 1	Quartz, containing crystals of zoisite (?)	do.
35	39	" 1	Do. do	do.
36	43	" 1	Blue argillaceous slate, ("roofing slate" F.)	do.
37	44	" 1	Do. do	do.
38	45	" 1	Bluish gray limestone	Below Twin falls, Menomoneek
39	46	" 1	Do.	do.
40	47	" 1	Quartz and chlorite.	Little Bequinnesee falls, Menomoneek
41	49	" 1	Quartz and chlorite, vein	do.
42	48	" 1	Quartz and chlorite, containing copper pyrites	do.
43	50	" 1	Vein of quartz in slate, with octahedral crystals of magnetic iron	do.
44	51	" 1	Blue argillaceous slate, ("roofing slate" F.)	do.
45	52	" 1	Do. do.	do.
46	53	" 1	Talcose slate.	Big Bequinesee falls, Menomoneek
47	54	" 1	Do	do.
48	55	" 1	Mica slate, consisting of quartz and mica, gneissoid	do.
49	56	" 1	Red feldspar in quartz, with a little serpentine and white magnesian limestone	Sturgeon falls, Menomoneek
50	57	" 1	Magnesian limestone in serpentine, veinstone	do.
51	58	" 1	Diallage rock, ("sienite" F.)	do.
52	59	" 1	Do. do	do.
53	60	" 1	Sienite, principally black hornblende	do.
54	61	" 1	Crystals of red feldspar	do.
55	62	" 1	Do.	do.
56	63	" 1	Slate with specks of copper pyrites	do.
57	64	" 1	Porphyry with red feldspar	2½ miles below Sturgeon falls, Menomoneek.
58	65	" 1	Do. do.	do.
59	66	" 1	Porphyritic trap, ("porphyry" F.)	Head of Pemenee falls, Menomoneek
60	67	" 1	Diallage rock ("sienite" F.)	Head isl'd above Pem. falls, Menomoneek.
61	106	" 1	Greenstone trap ("basaltic trap" F.)	Quiver falls, Menomoneek
62	107	" 1	Greenstone trap, lighter green, ("porphyry" F.)	do.
63	108	" 1	Do. do. do	do.
64	14	" 1	Decomposed ferruginous limestone, lower silurian	Near the mouth of Menomoneek
65	17	" 1	Do. do.	do.
66	15	" 1	Brown magnesian limestone, lower silurian	do.
67	16	" 1	Do. do.	do.
68	18	" 1	Do. do.	At the mouth of Menomoneek
69	19	" 1	Do do.	do.
70	20	" 1	Brown magnesian limestone, lower silurian; *no* "organic remains"	do.
71	73	" 1	Slaty gray compact magnesian limestone, ("marble" F.)	44, 31, 27, and 28, Machigamig river
72	74	" 1	Light drab colored magnesian limestone	do.
73	68	" 1	Compact magnesian limestone, drab and pink colored ("marble" F.)	44, 31, 27, Machigamig river

Catalogue of rocks, minerals, and ores, collected by J. W. Foster—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
74	69	F 1	Compact magnesian limestone, drab and pink colored, ("marble" F.)	44, 31, 27, Machigamig river
75	70	" 1	Do. ... do ... do	do
76	72	" 1	Do. ... do ... do	do
77	71	" 1	Do. ... do ... do	44, 30, 27, Machigamig river
78	77	" 1	Mica slate	Upper Portage, No. 9
79	78	" 1	Do.	Machigamig river, (Portage No 9)
80	80	" 1	Mica slate with large crystals of mica, ("granite" F.)	49, 30, 3, Machigamig river
81	81	" 1	Do. ... do ... do	do
82	82	" 1	Granite	42, 30, 33
83	83	" 1	Do.	45, 30, 5
84	79	" 1	Granite, coarse without, (apparently a boulder.)	40, 30, 30
85	90	" 1	Compact hornblende rock, ("amphibole rock" F.)	40, 30, 31
86	84	" 1	Mica slate with a little epidote with the iron, ("metamorphic rock" F.)	40, 30, 31
87	85	" 1	Micaceous specular iron ore with red silicious bands; too silicious for working ores	do
88	86	" 1	Do. ... do ... do	do
89	87	" 1	Do. ... do ... do	do
90	89	" 1	Do. ... do ... do	do
91	88	" 1	Micaceous specular iron ore, wavy with nodules of silex; too silicious for working ores	do
92	103	" 1	Micaceous specular iron ore, rich and pure	do
93	105	" 1	Do.	do
94	104	" 1	Mixture of magnetic and specular iron ore, very rich	do
95	75	" 1	Hornblende slate	41, 31, Machigamig falls
96	76	" 1	Do.	do
97	91	" 1	Compact trap, ("amphibole" F.)	50, 33, 35, Fall river
98	92	" 1	Argillaceous slate, ("chlorite rock" F.)	50, 33, 35, near S. line of Fall river
99	93	" 1	Do. ... do	do
100	95	" 1	Magnetic iron ore	48, 30, 20, NW. ¼ section Magiagino
101	94	" 1	Do.	48, 31, 20, NW. ¼ section Magiagino
102	96	" 1	Do.	do
103	97	" 1	Compact quartz rock ("amphibole" F.)	48, 31, 17, NW. ¼ section Magiagino
104	98	" 1	Granular quartz rock, ("metamorphic" F.)	do

105	109	W 1	Gray quartz rock, (quartz and feldspar, "metamorphic" F.)	do.
106	99	F 1	Gneissoid granite	48, 31, 17, SW. ¼ section Sagiagino
107	100	" 1	Do.	do.
108	101	" 1	Do.	40, 33, N. part of Sagiaginó
109	102	" 1	Hornblende rock, ("sienite" F.)	40, 32

Catalogue of the rocks, minerals, &c., collected on the district between Portage and Montreal river, during the years 1847 *and* 1848, *by J. D. Whitney.*

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
1	1	W 1	Mixture of epidote and a little quartz, very rich in native copper regularly divided through the mass. This piece is estimated to yield 60 per cent.	52, 37, 36, Algonquin Mining Company
2	2	" 1	Same as No. 1, but not quite so rich in copper. The mixture shows a tendency to amygdaloidal structure, the copper often being in rounded or spherical masses, and a good deal coated with red oxide	do.
3	3	" 1	Rock resembling No. 2, but more amygdaloidal, the base being an epidote trap, with amygdules of quartz. The amygdules of quartz are surrounded by a coating of granular epidote. This specimen contains but little copper and that in the quartz amygdules	do.
4	4	" 1	Fragment of a vein of quartz, 4 inches wide, with layers of chlorite trap on the exterior forming selvedges. This quartz contains 4 to 5 per cent. of native copper disseminated through it in fine scales	51, 37, 16, Douglas Houghton Mining Co.
5	5	" 1	Vein of quartz, colored rose red by sub-oxide of copper, metallic copper disseminated through it in thin sheets. Some spar mixed with the quartz	do.
6	6	" 1	Same as No. 5, contains Jacksonite mixed with the quartz	do.
7	7	" 1	Quartz colored by sub-oxide of copper, with veins of chlorite and considerable metallic copper. One side of the specimen is covered with crystals of quartz and red feldspar	do.
8	8	" 1	Crystallized red feldspar and quartz in chlorite and quartz with native copper	do.
9	9	" 1	Group of crystalized red feldspar in indistinct aggregation, a mixed chloritic and quartzose rock containing native copper	do.
10	130	" 1	Compact greenstone trap	51, 37, 16, shaft of Douglas Houghton Mining Company

Catalogue of rocks, minerals, and ores, collected by J. D. Whitney.—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
11	10	W 1	A joint of trap which gradually passes into a basaltic trap. The specimen seems to be compact epidote and magnetic iron with a little quartz disseminated through it	51, 37, 16, from a trap bluff
12	11	" 1	Mass of native copper found associated with No. 12, (13)	50, 39, 16, Minnesota Company
13	12	" 1	Rock composed principally of red feldspar with magnetic oxide of iron and epidote intermixed; occurs with native copper irregularly scattered through it	do.
14	13	" 1	Epidote and calc. spar with native copper	50, 39, 15, Minnesota Company
15	14	" 1	Epidote, massive with thin scales of copper, principally on faces of joints of fracture	do.
16	15	" 1	Native copper in epidote from an abandoned shaft	50, 39, 22, Ontonagon Company
17	16	" 1	Calcareous spar and epidote with native copper	do. do.
18	17	" 1	Ferruginous quartz with vein of quartz and calc. spar coated with epidote	50, 39, 16, in bed of brook near cabins
19	18	" 1	Yellow paper (yellowish brown quartzose rock, occurs mixed with epidote and trap, W)	do. do.
20	19	" 1	Imperfect red jasper with narrow bands of epidote	50, 39, 19, Randolph's
21	20	" 1	Quartz with serpentine and specks of copper	50, 39, 31, Ontonagon Co., from drift
22	21	" 1	Massive epidote, structure somewhat amygdaloidal, amygdules filled with quartz, thin scales of native copper covering nearly the whole surface of natural joints, interior of specimen almost destitute of copper scales, tarnished with iridescent colors slightly	50, 40, 36, Ontonagon Co., from drift
23	22	" 1	Resembles No. 21 (22) but more amygdaloidal	do. do.
24	23	" 1	Large sheet of native copper in partly disintegrated epidote rock, resembling old boiler copper	do. do.
25	24	" 1	Native copper investing surface of trap, from drift	do. do.
26	25	" 1	Amygdaloidal trap, cavities filled with radiated epidote	do. do.
27	26	" 1	Compact epidote rock, trappose structure, breaking into small angular fragments, has a tendency to amygdaloidal structure, and has fine specks of epidote scattered through it; much of the rock round the mine is of this character, and it passes imperceptibly into trap	do. do.
28	27	" 1	Brown jasper	
29	28	" 1	Epidote rock containing irregular fragments of quartz	35, United States Loc.
30	29	" 1	Amygdaloidal trap, cavities filled with epidote and quartz, principally the	

			former	do.
31	30	" 1	Rock breccia, a mixture of trap rock, epidote, calc. spar, and quartz, in drift	34, United States Loc., near cabin
32	31	" 1	Breccia of trap and sandstone	36, near south line
33	32	" 1	Red porphyry with crystals of red and white feldspar ("quartzose porphyry, base red quartzose rock, crystals of white feldspar sparsely scattered through it," W)	34, Half mile east of western boundary of township High-hill, named by us Porphyry, H. M
34	33	" 1	Gray silicious sulphuret of copper and crystallized sulphate of baryta implanted on it	18, Mendenhall, from shaft
35	34	" 1	Crystallized sulphate of baryta	18, Mendenhall, from shaft, in conglomerate.
36	35	" 1	Missing ("carbonate of lime, six sided prisms and hemitropes of a rare form on a vein of sulphuret of copper," W.)	do. do.
37	36	" 1	Prismatic slate ("black argillaceous sandstone, breaking into rhombohedral fragments," W.)	18, Mendenhall, in bed of brook near cabins.
38	37	" 1	Prismatic slate ("same as No. 36, rhombohedron with very regular sides, natural fracture of sandstone," W.)	do. do.
39	38	" 1	Massive epidote with fine particles of native copper disseminated through it, say 10 to 15 per cent	49, 41, 12, Ohio Trap-rock Co., northwest corner from principal shaft
40	39	" 1	Quartz with native copper	do. do.
41	40	" 1	Epidote with native copper	do. do.
42	41	" 1	Radiated epidote	do. do.
43	42	" 1	Quartz and epidote with incrustation of radiated epidote, native copper in the quartz	do. do.
44	43	" 1	Crystallized quartz and radiated epidote	do. do.
45	44	" 1	Calcareous spar and native copper	do. do.
46	45	" 1	Impure epidote with a small per centage of copper	do. do.
47	46	" 1	Native copper encrusted with earthy matter stained by green carbonate copper.	49, 41, 12, Ohio Trap-rock Co., from vein.
48	47	" 1	Radiated epidote in quartz with a small per centage of native copper scattered through it	11, Boston & Lake Superior Co., 2° on broken shaft
49	48	" 1	Epidote and quartz with native copper	11, American Exploring Co.
50	49	" 1	Epidote with copper scattered through the mass in fine particles, per centage small	do.
51	50	" 1	Radiated epidote in quartz with native copper	do.
52	51	" 1	Prehnite calc. spar and quartz	9, American Exploring Co., western location, in bed of brook near cabins
53	52	" 1	Dark-slaty sandstone, ripple marked	51, 42, 12, bed of Iron river
54	53	" 1	Red slaty sandstone, overlaid by amygdaloidal trap	16 and 21, on line between 16 and 21, ¾ miles west of east corner

Catalogue of rocks, minerals, and ores, collected by J. D. Whitney—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
55	54	W 1	Amygdaloidal trap, characteristic base reddish trap, amygdules filled with chlorite	16 and 21, on back of hill
56	55	" 1	Altered sandstone, or dark brown imperfect jasper, has a trappose structure	51, 42, 16, and 21, position of summit of hill between 53 and 54
57	56	" 1	Bed of chloritic trap, amygdaloidal, amygdules filled with chlorite	27, Union river, Minnesota Co
58	57	" 1	Same rock, but base of amygdaloid more chloritic, native copper in scales on the rock	do
59	58	" 1	Imperfect elongated crystals of native copper, from drift	do
60	59	" 1	Amygdaloidal chloritic trap, with fine particles of native copper scattered through it	27, Union river, Minnesota Co., from south drift
61	60	" 1	Same as No. 59, copper seems to be confined to the surface of natural fracture	do do
62	61	" 1	Sandstone with coating of native copper, from drift of	Union river, Minnesota Co
63	62	" 1	Slaty sandstone at junction with trap	In bed of Union river, near mine
64	63	" 1	Quartz and calc. spar colored by copper, in trap	do
65	64	" 1	Quartz and Jacksonite from vein in trap	22, Boston Mining Co
66	65	" 1	Same specimen contains a few fine particles of native copper	do
67	66	" 1	Polished surface of trap (slicken sides) from shaft of	do
68	67	" 1	Breccia of sandstone and conglomerate	30 and 19, ¼ mile east of western boundary of township
69	68	" 1	Coarse grained sandstone	do
70	69	" 1	Quartzose rock, imperfect jasper	do
71	79	" 1	Amygdaloidal trap rock; amygdules filled with chlorite	30 and 19, bed of Carp river
72	71	" 1	Nodules of rock with red oxide of copper	49, 42, Boyd's location
73	72	" 1	Trap with native copper	do
74	73	" 1	Trap stained with red oxide of copper, with green carb. of native copper	do
75	74	" 1	Epidote rock	do
76	75	" 1	Epidote rock with nodules of quartz and native copper	49, 42
77	76	" 1	Breccia, brown jasper, and epidote, little native copper	49, 42
78	77	" 1	Epidote trap with a little copper	48, 42, 6, Charter Oak Co
79	78	" 1	Epidote trap with small grains of copper	48, 42, 5 do
80	79	" 1	Trap	48, 42, 6 do
81	80	" 1	Hornblende rock obscurely stratified. ("Hornblende and quartz rock," W.)	46, 41, 24

82	81	" 1	Chlorite and red feldspar, forming veins in No. 80	46, 41, 24
83	82	" 1	Mica slate containing small garnets	46, 41, 35
84	83	" 1	Hornblende rock	45, 43, 1
85	84	" 1	Fine grained mica slate	do.
86	85	" 1	Thin strata of metallic copper, coated with red oxide in sandstone; "from red oxide vein," W.	51, 43, 14, Isle Royal Co's. location
87	86	" 1	Fragment of one of the rounded masses of sandstone and spar found between trap and sandstone	do.
88	87	" 1	Sandstone breccia with sulphuret of copper and a little carbonate	51, 43, 27, Delavan Co.
89	88	" 1	Crystallized carb. lime in sandstone breccia, with a little sulphuret of copper	do.
90	89	" 1	Amygdaloidal trap; cavities filled with crystallized epidote on the exterior, and quartzose within	do.
91	90	" 1	Breccia composed of jasper in particles in an impure epidote base, with much calc. spar	do.
92	91	" 1	Amygdaloidal trap; cavities filled with a yellow pulverulent substance supposed to be decomposed epidote (?)	51, 43, 32, Croton Co
93	92	" 1	Massive epidote rock	do.
94	93	" 1	Epidote and native copper with some quartz	51, 43, 30, Isle Royal Co
95	94	" 1	Trap with epidote veins; copper in the epidote	
96	95	" 1	Altered sandstone and jasper forming a ledge	51, 43, 32 and 33, ¼ mile past south boundary of township
97	96	" 1	Jasper	do.
98	97	" 1	Red and white quartzose rock	51, 43, 32, near summit of hill
99	98	" 1	Near junction of trap and quartzose rock	do.
100	99	" 1	Jasper and quartz rock	50, 43, 1, southeast corner
101	100	" 1	Brown sandstone	50, 43, 12, 1½ miles south of northern boundary of township on E. R. line
102	101	" 1	Porphyry, feldspar base; red feldspar, crystals, and quartz disseminated through it	49, 43, 33 and 34, on S. boundary
103	102	" 1	A dark mineral like labradorite scattered through the base	do.
104	103	" 1	Brown red porphyry. ("Red porphyritic trap," W)	50, 42, 32, (64 chains)
105	104	" 1	Red porphyritic trap	49, 42, 14, (?)
106	105	" 1	Mixture of trap, epidote, and calc. spar	50, 44, Atlas Mining Co
107	106	" 1	Mixture of trap with very minute particles of copper	do.
108	107	" 1	Mixture of trap with crystallized quartz	do.
109	108	" 1	Crystallized quartz, prehnite, and datholite	do.
110	109	" 1	Compact trap. Bed of Presque Isle river	49, 45, location 149
111	110	" 1	Very fine grained compact trap	Tyler's location
112	111	" 1	Laumonite	do.
113	112	" 1	Quartz, prehnite, and a minute film of sulphuret of copper	do.
114	113	" 1	Greenstone trap, contains fine particles of iron pyrites	47, 45, 19

Catalogue of rocks, minerals, and ores, collected by J. D. Whitney.—Continued.

Progressive No.	No. of specimens.	No. of box.	Description.	Locality.
115	114	W 1	Very fine grained greenstone	49, 46, 9
116	115	" 1	Fine dark argillaceous sandstone, thin layers	Mouth of Black river
117	116	" 1	Compact amygdaloidal chlorite rock; amygdules filled with white feldspar. ("Epidote rock," W.)	32, Black River Mining Co
118	117	" 1	Vein of quartz in trap with a few specks of sulphate of copper	32, bed of Black river at shaft
119	118	" 1	Amygdaloid produced by fusion of trap and sandstone. (Nondescript rock made up of a greenish epidote, trap, and oxide of iron)	do.
120	119	" 1	Granite composed mostly of quartz and feldspar; the feldspar largely predominates, and is both white and red, with a few minute specks of black mica and chlorite	47, 46, 31
122	121	" 1	Granite composed principally of greyish green feldspar and quartz	do.
123	122	" 1	Hornblende rock containing minute specks of sulphate of iron	47, 46, 1
124	123	" 1	Do. do.	do.
125	124	" 1	Magnetic oxide of iron in quartz and feldspar, granite	
126	125	" 1	Native copper in bluish green quartzose rock, colored by chlorite	48, 49, loc. of Montreal River Mining Co.
127	126	" 1	Quartzose seam in amygdaloidal trap	48, 49, from a so called vein of this Co
128	127	" 1	Quartzose gradually passing into trap	
129	128	" 1	Missing	
130	129	" 1	Do.	
131	131	" 1	Large mass of native copper in veinstone, containing calc. spar with chlorite on the border; red feldspar mixed with the copper	No locality given

Catalogue of geological specimens collected by Dr. D. D. Owen, *and deposited in the Smithsonian Institution by the Commissioner of the Land Office, December,* 1851.

1. Amethystine quartz, Prince's Bay, Lake Superior.
2. Lepidodendron, Muscatine quarries, Iowa.
3. do. do. do.
4. Pecopteris, do. do.
5. Calc. tufa., St. Croix.

6 and 7. Tutenmergel, near Amsterdam, Des Moines R., Iowa.
8 and 9. Lithostrotion ananas, D'Orb., Iowa R., Dev.
10 and 11. Tutenmergel, Keith's Rapids, Des Moines R., Iowa.

12. Plaster stone, 5 miles below Lizard Fork, Des Moines.
13. Cannel coal, Barcroft bank, near Marion, Missouri.
14. Palæotherium Proutii, 2 lower jaw, Bad Lands, Nebraska,
15. Ripple marked sandstone, South shore, Lake Superior.
16. do. do. do.
17. Fossil turtle, Bad Lands, Nebraska.
18. Shell beds of the limestone of the Iowa, Devonian.
19. Calc. spar crystals, Falls St. Croix.
20. Lingula bed, F. 1, b. of report, Falls St. Croix.
21. do. do. do.
22. do. do. do.
23. Marine Mill trilobite grit, 4th trilobite bed of report, St. Croix.
24. Portion of large ammonite, Fox Hills, Nebraska.
25. do. do. do.
26. do. do. do.
27. Third trilobite bed, Mountain Island, Upper Miss.
28. do. do. do.
29. do. near Mouth Miniskah,
30. do. do. do.
31. Cannel coal, on branch of Aux Vasse, Callaway Co., Missouri.
32. Coralline beds of Iowa city, containing Alveolites, Celleporites of D'Orb., Calamapora polymorpha of Goldf., pl. 27, fig. 3.
33. Do., containing Favosites cronigera, D'Orb.
34. Do., containing both corals. Pl. 27, fig. 3.
35. Orthis umbraculum, opposite Iowa Point, Missouri R.
36. Selenite from the upper Carbs. limestone, Indian Creek, Iowa.
37. Leptæna limestone, containing L. planumbona, 3 miles above Savannah, Wisconsin.
38. Do., containing L. sericea.
39.
40. Bituminous limestone, containing Asaphus (Isotelus) megistos of Locke, Otter creek, Turkey R , Iowa.
41. Part of scapula of Palæotherium Proutii, Bad lands.
42. Casts of Leptæna, undet, Falls St. Anthony, F. 3, a of report.
43. Oolitic limestone, Lower Carbs. limestone, Burlington, Iowa.
44. Retepora Archimedes, Keokuck Rapids.
45. Encrinital limestone from the Lower Carb. limestone of Burlington, Iowa.
46. Do., containing Pentremites melo.

47. Productal limestone, containing P. Cancrini, 10 miles below Fort Kearney, Missouri river.
48. Spirifer striatus limestone, upper beds of Carb. limestone of Augusta, Iowa.
49. Productus punctatus, Keokuk Rapids, Miss.
50. Do.
51. Do.
52. Do.
53. Fusulina cylindrica in Carboniferous limestone, 10 miles below Fort Kearney, Missouri.
54. Fucoidal beds, Marine Mills, St. Croix, F 1, d, in part.
55. Lithostrotion, probably a var. of basaltica, Sugar creek near the Iowa line.
56. Stromatopora concentrica, Iowa city, Dev.
57. Productal limestone, a few miles above the Racoon Forks on the Des Moines River.
58. Head of femur of Palæotherium Proutii? Bad Lands.
59. Magnesian limestone, with green particles of silicate of iron disseminated, intercalated with the lower sandstones, F. 1, of report. (Lower Silurian date,) Sac Prairie, Wisconsin river.
60. Magnesian limestone, intercalated with F. 1, 14 miles above Sac Prairie.
61. Lower sandstone, F 1 of report. Dalles of the Wisconsin river.
62. Lower sandstone, F 1, (Lower Silurian date,) 7 miles below Helena, Wisconsin river.
63. Magnesio-calcareous bed containing impressions of Orthis intercalated in F 1. Section 5 miles above Plymouth, Wisconsin river, 138 feet above river.
64. Magnesio-calcareous rock, intercalated in F 1, 143 ft. above Wisconsin river, 5 miles above Plymouth. Contains remains of encrinites.
65. Lower sandstone, F 1. Petenwell Peak, 200 ft. above the Wisconsin, (Lower Silurian date.)
66. Do. of Castle Rock, 65 feet above Wisconsin river.
67. Green beds of F 1 d. charged with silicate of iron. Miniskah Pass, Upper Mississippi.
68. Brown magn. calc. bed of F 1 d. Miniskah, Upper Mississippi.
69. Lower sandstone of Petenwell Peak, 80 feet above Wisconsin.
70. Lower sandstone, F 1, $5\frac{3}{4}$ miles east of Adams, Barraboo river.
71. Quartzite, $5\frac{3}{4}$ m. e. of Adams, Barraboo river, Wisconsin.
72. Do. gray.
73. Red beds of Lower sandstone, F 1, 1 m. above Fortification Rock, Wisconsin river.
73'. Yellowish-red beds of F 1. Castle Rock, 35 feet above the Wisconsin river.
74. Quartzite in F 1, between the Wisconsin river and Adams on the Barraboo.
75. Reddish quartzite $2\frac{1}{2}$ m. e. of Adams, on the Barraboo river, Wisconsin.
76. Light pink quartzite, sec. 34, township 12, R. 6 east of 4th P M, Wisconsin.
7. Gray quartzite, Devil's Lake, Wisconsin

78. Pink quartzite, F 1, Devil's Lake, Wisconsin.
79. Conglomerate of F 1, Devil's Lake, Wisconsin.
80. Obolus beds of F 1, b. Miniskah River.
81. Lower Magnesian Limestone, F 2, 3 miles above Lansing Iowa.
82. Lower Magnesian Limestone, F 2, Cape Winnebago, Upper Mississippi.
83. Red Conglomerate, below Lac Travers, Snake River, Minnesota.
84. Specular Iron, associated with the quartzite, 2½ m. E. of Adams, Barraboo River, Wisconsin.
85. Do. with the milky quartz.
86. Cherty masses, in F 2, b. near Lanzing, Iowa.
87. Cellular quartz, in F 2, b. do. in the lead bearing beds.
88. Rugged cherty beds of Lower Magnesian Limestone, (lead bearing beds,) near the mouth of the Kickapoo, Wisconsin.
89. Lower Magnesian Limestone, F 2, a. Prairie á la Crosse, Wisconsin.
90. Do. 20 feet below the top of section.
91. Crystallizations of hydrate brown oxide of iron, on chest in beds F 2, b. of Lower Magnesian Limestone. Prairie á la Crosse, Wisconsin.
92. Kikapoo Copper ore. Sterling's Diggings.
93. Kikapoo Lead ore, (Galena,) in F 2, b.
94. Coarse green Lingula grit, F 1, c. Lawrence creek, near the St. Croix River.
95. Coarse Lingula grit, F 1, c. Mountain Island, Wisconsin.
96. Amygdaloid asssociated with the trap of Snake River, Minnesota, near Lac Travers.
97. Do.
98. Trap of Snake River, ½ mile below Lac Travers, Minnesota.
99. Do. 2 miles below Lac Travers.
100. Trap of Kettle River, 3 m. above its mouth, Minnesota.
101. Do. 16 miles above its mouth.
102. Greenstone trap from the Range near the Falls of the St. Croix, Minnesota.
103. Porphyritic trap, Falls St. Croix, Minnesota.
104. Obolus grit, F. 1, b., nearly opposite old mouth of Black river, Mississippi river.
105. Slab, full of lingulas, &c., from the Falls St. Croix, F. 1, b.
106. Pebbly sandstone, of F. 1, a. L'Eau Clair.
107. Coarse sandstone, F. 1, a., six miles below the falls of the Chippewa, Wisconsin.
108. Fragmentary and concretionary bed of limestone, above the coralline beds at Iowa city. Dev.
109. Favosites basaltica, Cam. Calamopora of Goldf., pl. 26, fig. 4, from the coralline beds of Iowa city.
110. Do.
111. 5th trilobite of F. 1, near the base of La Grange Mountain, upper Mississippi.
112. 5th trilobite bed of F. 1 of Report, lake St. Croix, Minnesota.
113. Limestone containing Retepora prisca? Fenestela chætetes, &c. Upper carboniferous limestone, near mouth of Missouri.

114. Spirifer limestone, near top of the lower carboniferous series, Keokuk Rapids, Mississippi.

115. Do.

116. Iron stone, similar to the "black band" of the Scotch iron masters, near Bennington, and elsewhere on the Des Moines river.

CATALOGUE
OF
BERLANDIER'S HISTORICAL AND GEOGRAPHICAL MSS.*

In the year 1826 Luis Berlandier, historian, geographer, and naturalist, a native of Switzerland, arrived in Mexico for the purpose of making researches in that republic. He died near Matamoros in 1851. The result of his extensive labors are in manuscripts, now deposited at the Smithsonian Institution, comprising an amount of information of the country west of the Sabine of the highest importance.

The following is a brief catalogue of the MSS.:

Travels in Mexico and Texas, 1826 to 1834, inclusive. Containing notes upon the statistics, early settlements, and Indian tribes between the Sabine and Pacific, &c., &c., &c.—7 vols.

Travels in Mexico, 1828–'30. Comprising interesting notes of the early settlers of Texas, by the Spanish and French; account of the ancient Indian tribes, &c., &c.—3 vols.

Geography and statistics of the republic of Mexico.

History of the Indian tribes that formerly ranged from the Sabine to the gulf of California.—2 vols.

Notes upon the different Indian tribes of the ancient republic.—1 vol.

Vocabularies of different tribes bordering the Rio Grande.—1 vol.

Of the Cotonames, Carrissos.—1 vol.

Of Indians that formerly lived to the northeast of Texas.—1 vol.

Of different tribes in the neighborhood of the missions.—1 vol.

Revolt of the Tepeguanas, 1616.—1 vol.

Indian assassinations of the priests.—1 vol.

Of the Texian Indians. Buit.—1 vol.

Indians of Texas and Coahuila; fertility of their soil, &c.—1 vol.

Medicine of the ancient and modern Indians of Mexico.—1 vol.

Paintings of thirty different Indian tribes.—1 vol.

History of the agriculture of ancient and modern Mexico.—1 vol.

Regulations of the ancient Presidios, 1772.

1.—Travels in Tamaulipas and New Leon, 1844.

2.— " " Tamaulipas, San Luis Potosi, 1846.

3.— " " the country west and south of Matamoros, 1847.

The above vols., 1, 2, 3, of travels, give an interesting history of the country adjacent to the Sierra Madre.

March and espionage of the American army from Corpus Christi till the occupation of Matamoros.—1 vol.

Geographical Gazetteer of the territory lying between the Sabine and Pacific, comprising a history of places, situations, positions, &c., &c.—12 vols.

Geography of ancient and modern Mexico.—1 vol. notes.

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* See p. 13 of this Report.

Geography of Puebla, Mexico, Mechoacan, Oaxaca. Position of places in the above Archbishoprics.—1 vol. notes.

Diary of the Commission of Limits in Northern Mexico, 1830.—3 vols.

Diary of Gen. Rivera, New Mexico and Texas, 1728.—1 vol.

Com. Limits, Geography and stat. Physiques, &c., &c., by various authors, with notes by Berlandier.—Notes.

Astronomical observations made in Northern Mexico, Texas, &c.—6 volumes.

Dictionary. Geology of the rocks and minerals between the Sabine and Sierra Madre.

Upon the Meteorology of Texas and the valley of the Rio Grande, comprising some important deductions in the science.—15 vols.

Observations, cyanometer, pendelum.—2 vols.

Disquisitions upon the Fevers of the lower Rio Grande, &c., &c., &c. —Notes.

Maps of States accurately and scientifically projected by Berlandier, member of the Geographical Society, viz: Tamaulipas, Vera Cruz, San Luis Potosi, Zacatacas, Juanaxata, Orirava, Tampico and adjacent country. Gulf of Mexico, vicinity of Vera Cruz.

Maps in MSS. of journeys, routes, valleys, defiles, suburbs of towns, villages, &c., &c., of the country lying between the Sabine and Rio Grande and valley of Mexico.

1.—Topography of routes and sections in New Leon, Tamaulipas, San Luis Potosi, made in 1844, with distances.

do. do. from San Luis to Matehuala, distances, &c.

do. do. from Matamoros to Morelos, Guajuco, &c.

2.— do. from Victoria to Tampico, Soto la Mariana Santander.

do. Matehuala to Boquillo, Palo Blanco to Missions.

do. Tampico to the city of Mexico.

do. Tampico to Matamoros, accompanied with notes.

3.—Topography in detail of the route from San Antouia to Laredo, in Tamaulipas, &c., &c.

Of the country between Matamoros, Barreales, Mosquete, Caracol and Anacahuetas, Tamaulipas. Survey of the Rio Grande from the mouth to San Elirario, plans of Presidios, &c., &c. Maps and topography of different portions of the country south of the Rio Grande, between Reynosa and San Fernando. 12 MSS. Tampico and its environs, lower Tamaulipas, San Patricio and Monclova, city and environs of Tampico, plans of Tamaulipas, of different sections of the State, &c., &c., and 13 maps in MSS. Various routes of ancient Texas, giving positions of the Indian tribes that formerly inhabited Missions. Different plans of the State, sections, ancient maps, &c., &c. 25 maps in MSS.

Upper Tamaulipas, Coahuila, N. Leon, with topography in detail of various routes in the centre of the Republic, bars and entrances of the coast south of Brasos Santiago, &c., &c., &c. 23 maps in MMS.

Maps of different portions of the coast between Tampico and River Goasacoalco, 8 MSS.

Department of Orizava, Jalapa, Canton of Cordova, Orirava, Cosamaloapan, plan of Cordova and Birava cities, &c.; of the Isthmus

of Tehuantepec; State of Mexico, of the Lakes, Valley, Tenango, Queretaro. The Huasteca, San Luis, routes through the Sierra Madre east and north, valley of Vernallo, Mateuala to the north and east, &c., &c., 16 MSS.

Topography in detail, of the country lying between San Luis and San Fernando, Gulf coast, &c., &c., 6 MSS.

CIRCULAR.

[See page 23 of this report.]

SMITHSONIAN INSTITUTION,
Washington, March 22, 1855.

Nearly five years have elapsed since the publication of a report on the Public Libraries in the United States by the Smithsonian Institution. This report contained all the information respecting American Libraries which could be collected at that time; but great changes have taken place in the Libraries then in existence, numerous others have since been established, and a new and enlarged edition of the work, it is believed, will supply a want much felt. The following circular has therefore been prepared for the purpose of collecting information relative to Libraries, and it is particularly desired that the answers be transmitted without delay to this Institution. As some of the questions may relate to points which have not heretofore received your attention, it is suggested that the replies be now forwarded to those only which can be answered at once, and that the other blanks be filled up and returned, when the materials can be collected.

It is a part of the original plan of the Smithsonian Institution to render it a centre of bibliographical knowledge, and for this purpose it is deemed highly desirable to collect cataloges of all the libraries in the country. The student can then learn where to find any particular book by addressing the Smithsonian Institution.

It is suggested that catalogues of all libraries be printed, in order that they may be rendered more generally useful, and it is earnestly requested that copies of these be sent to the Smithsonian Institution.

A duplicate circular is enclosed, which you are requested to fill up at the end of the present year.

A copy of the Report will be sent to every Library in the United States, and another also to the individual furnishing information.

JOSEPH HENRY,
Secretary Smithsonian Institution.

SMITHSONIAN REPORT ON PUBLIC LIBRARIES IN THE UNITED STATES.

Please return this paper with the answers to the Smithsonian Institution, Washington, D. C.

1. Name of Library.
2. Locality.
3. Name and address of the Librarian?
4. Officers employed, and their salaries?
5. When founded, and by whom.
6. How supported and governed.

7. Receipts from all sources during 1854, $
8. Expenditures during 1854 for Books, $
" " Binding,
" " Periodicals,
" " Salaries,
" " Incidentals,
9. Who are entitled to use the Library?
10. On what terms?
11. Is it a reference or a Lending Library?
Special, or Miscellaneous?
12. Are the books arranged on the shelves by subjects?
If not, what is the arrangement?
13. How many days and hours is the Library open?
14. How many *volumes* were lent during 1854?
15. How many *persons* have borrowed books during 1854?
16. What number of volumes in the Library are in the English language?—French?—
German?—Spanish?—Other Modern Languages?—Latin?—
Greek?—Hebrew?—Oriental?—
17. What is the date of the last printed Catalogue?
Cost of its publication, size, and number printed?
18. What system of classification is adopted in the construction of the Catalogue?
19. If possible, state what number of books have been read during 1854, in the different classes of literature—how many works of theology, law, medicine, fiction, &c.—and what particular books have been most called for.
20. On the 1st of January, 1855, how many books, &c., in the Library?

	Books.	Pamphlets.	Manuscripts.	Maps.	Music.	Engravings.	Specimens of fine arts.	Other articles, as coins, medals, &c.	Total.
Purchases									
Donations									
Exchanges.......									
Total........									

21. What collections of Natural History are connected in any way with the Library?
22. What is the nature and extent of these collections?
23 What other Natural History collections, public or private, are found in your neighborhood, and what is their character?
24. Have any regular publications of Memoirs, Transactions, Proceedings, &c., been made by any Institution or Society with which the Library is connected, and of what character and extent?
25. Please send copies of your Catalogue, Charter, Rules and Regulations, &c., and any information respecting the history or condi-

tion of the Library which you desire to be included in the Report; also a list of all Reviews, Magazines, and Newspapers taken regularly in your library or reading-room.

Copyright Laws, &c., relating to the Smithsonian Institution.

CIRCULAR.

SMITHSONIAN INSTITUTION, *Washington*, 1855.

SIR: Your attention is respectfully called to the fact that an act of Congress of August 10th, 1846, requires you to send to the library of the Smithsonian Institution a copy of any "*book, map, chart, musical composition, print, cut, or engraving*," which shall be copyrighted by you. The following is the law on the subject:

"*An act to establish the 'Smithsonian Institution,' &c.*

"SEC. 10. *And be it further enacted*, That the author or proprietor of any book, map, chart, musical composition, print, cut, or engraving, for which a copyright shall be secured under the existing acts of Congress, or those which shall hereafter be enacted respecting copyrights, shall, within three months from the publication of said book, map, chart, musical composition, print, cut, or engraving, deliver, or cause to be delivered, one copy of the same to the librarian of the Smithsonian Institution, and one copy to the librarian of the Congress Library, for the use of the said libraries.

"Approved August 10, 1846."

An act of Congress passed at its last session, and approved March 3d, 1855, contains the following section:

"SEC. 5. *And be it further enacted*, That all books, maps, and charts, or other publications entered for copyright, and which, under the act of August 10th, 1846, are required to be deposited in the Library of Congress, and in the Smithsonian Institution, may be sent through the mail free of postage, under such regulations as the Postmaster General may prescribe.

"Approved March 3, 1855.

The following instructions have just been issued by the Postmaster General in reference to these acts:

"No. 35. Copyright books, charts, &c., [see law annexed,] required to be delivered to the Library of Congress or Smithsonian Institution, and which are entitled to pass free in the mail, should be superscribed 'Copyright for Congress Library,' or 'Smithsonian Institution,' as the case may be."

These provisions will enable you to send all your copyright publications to the Institution free of charge, and you are requested to forward them by mail, in the manner indicated.

Please inform us by letter when any articles are sent, and enclose a postage stamp if you wish a certificate of deposit to be returned.

Very respectfully, your obedient servant,

JOSEPH HENRY,
Secretary Smithsonian Institution.

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